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Un Succès Fou

Some two or three years ago, a foundry manager (Mr. W. Wilson) and his foreman (Mr. A. Talbot) being short of apprentices applied themselves to the solution of the problem. They argued that the obvious source of entrants would be found in the state technical schools and to attract pupils to the foundry, their interest must be aroused. To create these conditions, the next obvious step was to gain the enthusiastic support of the teachers. Practical demonstrations were given, and became so popular that they culminated in being featured on the television programme. Like wildfire, the teaching of foundry practice spread to every technical school in the north Middlesex area and in a short space of time what was a dearth of apprentices was transformed into a plethora.

Here logistics reared up its ugly head and the question was raised by the educational authorities, "What was potential annual intake of foundry apprentices in the area?" Now, it so happens, that there are but two medium-size concerns making iron castings, and not many more engaged on non-ferrous metals. Thus, the only possible truthful answer was, "A handful." Hence, a *va piano* edict can be expected from the educational authorities, who are being pressed to interest boys in the building trades and light engineering, for which there is a steady demand. The reason for our title "a rebounding success," therefore becomes apparent.

As logic has both solved and shelved the problem, we might as well use this orderly method of thinking and applying it to national needs. To do this we must work backwards in search of a solution. First, to give a basis for inclusion in the curriculum, the annual intake for any scholastic area must be ascertained. Secondly, each area must produce a skilled foundryman who is sufficiently enthusiastic to devote some of his spare time to demonstrating his craft to the teachers at the local technical school. From experience, it would seem that interest is quickly generated and curricula adjusted to include moulding practice. From this extraordinary success and failure story, the moral to be extracted is plain. Let there be no moaning as to the inability to get recruits, but instead, pursue the system indicated. However, in fairness to the educational authorities, there must be established some realistic figures of annual intake. Actually, such statistics would be of great use to those operating day and evening classes on foundry practice. When classes are inaugurated, there is usually a good influx, but within one year, the classes became very attentuated and only enthusiasm on somebody's part manages to keep them alive. To get boys into the foundry is a question of salesmanship, but as an adjunct to salemanship, a market survey is invaluable.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

THE WHITE PAPER

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—May I, through your columns, welcome Mr. Giles (JOURNAL, October 23, p. 470) to the ranks of opposition to the proposed foundry autocracy? It should, however, be pointed out that the White Paper was published in July. You, yourself, had an excellent leader on the subject on July 31. The C.F.A. Bulletin for August presented a summary of the White Paper, and you were kind enough to publish a letter from me on August 28. It is to be hoped that founders will study more promptly the report of last Thursday's debate* in the House of Commons. From Hansard they will learn that the only voices raised against the extension of public control came from the Socialist benches.

Your, Sir, have always urged us to support our trade associations, and the Minister said he had consulted the "principal organizations." However, it would appear that the advice offered to the Minister was the opinion of the executive and not that of the subscription-paying members of the associations. The sole reason given by Mr. Sandys for the extension of public control over the foundry industry was that we "consume no less than 5½ million tons of pig-iron and scrap a year." Ironfoundries, as consumers, are to be controlled at the behest of the pig-iron producers. One wonders if it will also be proposed that consumers of the 16 or 17 million tons of steel produced annually will be controlled at the behest of the steelmakers?—Yours, etc.,

C. H. KAIN,
Joint Managing Director.
(For Lake & Elliot, Limited.)

* See "Parliamentary," page 517.

Dinner

At the conclusion of the National Works Visits Day of the Institute of British Foundrymen (last Friday) over 100 members and guests made a rendezvous at Porthcawl, for dinner at the Sea Bank Hotel. This was a very enjoyable affair, attended by the president and leading members of the Institute as well as officials of the South Wales and Monmouth branch. At this function, following the loyal toast, the success and continued progress of the Institute was proposed by County Alderman Llewellyn Heycock, J.P., chairman of Glamorgan Education Committee, who commended the part played by the Institute in craft and technical training for the industry—on his part, he hoped the 1944 Education Act would result in progressive improvement of basic education. The national president of the Institute, Dr. C. J. Dadswell, B.Sc., M.I.Mech.E., suitably responded, and then the toast of "The Guests" (which included visiting members of the Institute) was given by Mr. R. J. Richardson, past-president of what was then the Wales and West of England branch. The reply in this case was made by Mr. John Bell, now junior vice-president of the Institute and for many years secretary of the Scottish branch. Conversation at the dinner turned mainly on the events of the day, the worthwhile nature of the technical features absorbed and praise for the admirable arrangements for the visits. These were partly the responsibility of Mr. A. S. Wall, secretary of the local branch, his Council and stewards, and partly of the national secretariat at Manchester, represented at the dinner by Mr. Tom Makemson, M.B.E., and Mr. George Lambert.

City and Guilds Insignia Award

General details of the new award by the City and Guilds of London Institute for training in industry referred to editorially in the JOURNAL of October 16 have now been announced. The City and Guilds has, through its Department of Technology, hitherto discharged the duty laid upon it by Royal Charter to promote the advancement of technical education as an aid to industry through the medium of its certificates and awards at three levels. These are the well-known intermediate, final and full technological certificates respectively. The Institute considers that, in certain branches of industry, the time has now arrived when additional encouragement and recognition could usefully be given at a higher level than that represented by its full technological certificates to those engaged in industry who continue to pursue their studies and to broaden their knowledge. In furtherance of this objective the Institute proposes to establish under its Royal Charter an *Insignia Award in Technology* which will lay emphasis upon technical training based primarily upon practical experience, supplemented by theoretical study, as distinct from the more academic approach to training for which many educational facilities and inducements already exist. This new award is intended to be a mark of distinction for those who have combined with a sound practical training an adequate knowledge of the fundamental scientific principles of their industry, and who possess a capacity for leadership and administration.

The institution of this award has two further objects. In the first place, it will encourage those who have completed a course of training in some branch of industry to extend their studies to its broader problems, and to widen their knowledge of the scientific principles upon which their industry is based. In this way they will become better able to apply new methods to their work and to know when to seek the assistance of those with more advanced and specialized knowledge. The Institute also believes that the introduction of the award will encourage students to take full advantage of the facilities provided in industry and technical colleges and will lead to the recognition of the value of practical training and experience as basic requirements.

Scope

Having regard to the breadth of knowledge called for and the other conditions to be fulfilled, the standard of the Insignia Award will be well above that of any existing full technological certificate. The Institute intends to introduce the award gradually as opportunity offers in the main branches of the chemical, constructional, electrical, mechanical and textile industries. The co-operation and assistance of representatives of industry will be sought in judging the eligibility of candidates, so that the Insignia Award will be indicative of exceptional competence and will ensure that persons receiving it will be recognized as being both trained and qualified to occupy posts of technical and executive responsibility in the class of work and in the branch of industry specified on the warrant they will receive. Copies of the general regulations governing the Insignia Award scheme, together with notes for the guidance of candidates, and an application form for the registration of candidates (form CGIA/1) will be sent to any applicant on receipt of a stamped addressed foolscap envelope. Enquiries should be addressed to the director, Department of Technology (I.A.), 31, Brechin Place, South Kensington, London, S.W.7. Completed forms of registration should be returned similarly addressed.

Transport and Storage*

By C. H. Wilson

(Slightly abridged)

The Brassfoundry Productivity Team gained very little new knowledge in America on the problems of material handling. The Author, therefore, presents a case-study of the problem as solved by one company in this country, not with the suggestion that it is the best solution or, for that matter, the only solution, but because it may give ideas to help in individual problems. On a problem so essentially individual as material handling, made-to-measure answers will rarely be found. Satisfactory solutions developed in one factory are not necessarily suitable for adoption elsewhere, even though similar products are involved. It is the intention, then, in presenting this case-study to emphasize an approach to the problem and at the same time to illustrate some of the results achieved at one plant. In foundries, the methods described are generally applicable to handling in the fettling shop and subsequently.

What is material handling? The Author accepts the broad definition, namely, the handling of material, both manually and mechanically from receipt to despatch, whether applied on a national, industrial, factory or shop level. In other words, not only picking up and putting down, but to a large extent what goes on between picking up and putting down, because of the effect of correct positioning on subsequent processes or operations. On a national level it is found that 20 per cent. of the working population is employed in distribution and transport and half the remainder (the 40 per cent. engaged in manufacturing industries) are concerned either directly or indirectly with the handling of materials for a proportion of their working life; this proportion being directly related to the efficiency of the material-handling methods applied in each instance.

Magnitude of the Job

Inside the factory, it is known that material-handling is non-productive—adding nothing to profits, only to costs. If some products had to pay their own fares, the most profitable section of the organization would often be that of internal transport. As it is, every ton of finished work produced involves on average the movement of at least 50 tons in weight between processes, and it is further estimated that this handling—the so-called "graveyard of profits"—absorbs 22 per cent. of the total manufacturing cost. To be more specific, the terms of reference within the general framework of factory transport and storage is the study of practical and economic ways of handling batch production. It is known that the problems outlined in this case-study are similar in many ways to those experienced in other factories and foundries.

Case Study

Three broad considerations of this case study—(1) the problem; (2) the objective, and (3) the results to date—set the pattern for what follows. They are related to a particular study of the uncompleted efforts of the Author's firm over the past two years to improve its material-handling. This Company is engaged on the production of a wide variety of products, including gas appliances and water fittings which are organized on a product basis. The different departments occupy blocks of multi-storey buildings, some of which are 100 yrs. old, and consequently not the least of the difficulties arise from considerations of floor loading and differences in levels of equivalent floors in each block.

The problem is the handling in an existing factory of a diverse range of products in part or whole, of varying batch quantities from 10 to 10,000, through all stages of manufacture, covering, in order of product treatment (*a*) material-handling into the factory, (*b*) during operations, and (*c*) between operations. The latter involves local movement for process or product layouts, general movement, and storage. Finally, there is (*d*) material-handling for despatch.

The objective is the introduction of new methods of material-handling that will be in keeping with the general objective of greater all-round efficiency. The specific objective should result ultimately, therefore, in greater output for less cost—the theme of the conference. Greater output can be achieved as follow:—(*a*) By increasing the productive time available to an operator through the reduction of his or her handling time to a minimum; (*b*) by the provision of an efficient tool for material control, for

FIG. 1.—*Stacking Tray, 18 by 12 in. by 6 in. deep, weighing 14 lb. and capable of holding 30 to 35 lb. of Components.*

* Presented at the Brassfoundry Productivity Conference; the Author is a director of Evered & Company, Limited, and was deputy leader of the Brassfoundry Productivity Team.

FIG. 2.—*Method of Stacking Trays shown in Fig.* 1 *up to Six-high, the Components remaining partially Visible.*

assuring that the correct quantity of material could be in the right place at the right time, and (*c*) by guarding against possible damage to finished or semi-finished components. Less cost should result from (*a*) the reduction in the direct labour necessary for the promotion of the above, and (*b*) the efficient use of the remaining labour.

To be effective, all these considerations should take into account the human problems involved, such as the fear of redundancy arising from improved methods, and the present and future problems of the availability of labourers or " work feeders."

Results to date.—The account of the results to date which follows is mostly a record of accomplishment and partly a statement of intention, since the scheme outlined is not fully completed. It was decided at an early stage in the study of the problem that the simplest approach was to adopt some means whereby the wide range of components in various quantities could be considered, wherever possible, as forming a standard unit for handling. The outcome was a standard tray, and much thought was given to this " lowest common factor " of bulk movement which at the same time had to be the " highest common multiple " for a range of components. The success of the whole scheme depended upon a correct decision at this point, and fortunately, the tray did not have to be unduly large to contain several of the largest components, this perhaps being the limiting factor in its wider application.

Standard Unit

There were already in the factory several different designs and sizes of work trays in addition to a variety of tea-chests and barrels. Each type had its own particular virtues and limitations, but none measured up to all the requirements demanded, and it was decided, therefore, to design a special tray. Some of the considerations involved in the design were as follow:—(*a*) Convenient gross weight for manual lifting by male or female operatives; (*b*) to be reasonably full when holding the chosen weight of small components; (*c*) to hold a reasonable weight of large, possibly cored or light-alloy components; (*d*) embody adequate provision to facilitate manual lifting; (*e*) allow of stacking, one on another in a stable vertical column; (*f*) the contents of each tray should be visible when stacked in this way; (*g*) strong enough to support several full trays stacked above; (*h*) dimensions should be sensibly proportioned and not " look " heavy, and (*i*) should be suitable for running on standard gravity- or motorized-conveyor. The possibility of use by suppliers was also considered, as was the question of sides or bottoms of mesh material to facilitate product cleaning and swarf removal, and these features, in conjunction with the use of nesting trays to fit inside the standard tray for distribution of " assembly kits " of components, are to be incorporated at an appropriate time.

Fig. 1 shows the result arrived at in the case under review, and the size finally agreed upon was 18 in. long by 12 in. wide by 6 in. deep, the tray being made from welded 16 gauge mild-steel sheet, with 1¼ in. angle-iron corners. This particular size enables the weight of parts contained by the trays to average between 30 and 35 lb., the tray itself weighing 14 lb., making a total weight of 40 to 50 lb., which is within the capacity of girl operators as well as men engaged in machine operations. Extended corners to the tray allow them to rest comfortably on one another as shown in Fig. 2. The components in each tray are

FIG. 3.—*Manual Movement of Trays of Components by Truck and Stillage. Trays may be Stacked Vertically* 3- *or* 4-*high on the Stillage.*

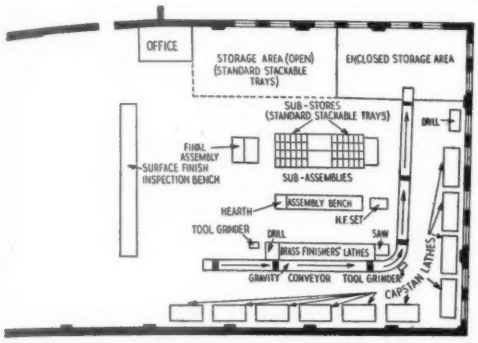

FIG. 4.—*Layout Plan showing how Trays of Completed Components can be delivered by Gravity Conveyor to a Stores from Machines lining the Walls.*

visible but in this case deliberately not accessible, although they could be if so desired. They are shown stacked six high, this requiring a lift of 40 in. for the top tray to be positioned or removed. A maximum of 1½ in. and minimum of 1 in. between stacked trays allows them to be slightly overfull if necessary.

The trays can, if so desired, be stacked 9- or 10-high, but without some mechanical means of stacking, this is not common practice, 6-high being usually sufficient for storing components which are consumed fairly quickly. Without strengthening the floors considerably, even pedestrian-controlled motor-driven stacking trucks were out of the question on upper storeys in the particular century-old building, although a lighter, manually-operated truck, if available, could be used. The self-stacking feature of these trays enables all the recognized principles of using "air space instead of floor space" to apply, with the consequent increase in productive space and a considerably neater appearance of stores and production shops. Illustrations are shown later of how these trays form the basis around which new shop-layouts can be more simply arranged; accepting the principle that plant and equipment should be positioned in accordance with the approved system of handling.

Material-handling on Receipt

The bulk of incoming material to the factory is in the form of die-castings or sand-castings, or hot-brass stampings, which invariably arrive in sacks and weigh up to 50 lb. gross. The short-term solution applied on receipt was to transfer all the components into standard trays as soon as practicable after off-loading from the lorry and this is successfully accomplished with little inconvenience. It is questionable whether a better solution can be found except where supplies from any one company are large enough to justify arrangements for delivery in the standard tray, this of course involving the circulation of an additional quantity of trays due to the requirement of returning empties. The long-term solution to this problem is probably to ask suppliers to deliver materials on stillages or pallets, which will allow unloading (and loading) by stillage truck or by fork-lift truck. An overhead chain conveyor has been installed for transporting work that has been unloaded from lorries (or delivered from other sections of the factory) on to the first and second storeys of the main production block, and thus it arrives at the correct starting point for the subsequent series of operations.

Local Movement and Process Layout

In departments or shops where the machines are grouped together according to process, manual movement by truck and stillage is still widely used, and in the case shown in Fig. 3, trays of components may be stacked 3- or 4-high in four vertical columns on a modified stillage for local movement to the next group of machines, or to a stores area where they become a compact mobile unit ready for instant movement. The stillage shown is the type that can be moved by a loose "tug bar," and requires less gangway space for withdrawal than the conventional stillage truck, although these are still widely used in conjunction with wooden pallets, and applied in the same way as shown in the illustration. Stillages may be left at the machine, or trays unloaded and stacked there. A neat appearance results and eventually the operators will have tables at each side, working from and into trays placed on them at the correct height.

Not all batches, however, are large enough to constitute a load of 12 or 16 trays, although, of course, a composite load may be moved together to the stores or to the next process. The shop-layout shown in Fig. 4 illustrates how trays of completed work can

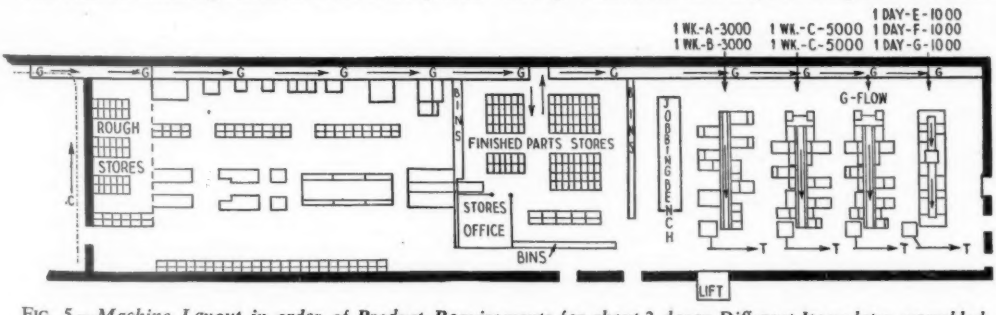

FIG. 5.—*Machine Layout in order of Product Requirements for about 3 dozen Different Items later assembled at the Other End of the Department.*

FIG. 6.—*Inter-process Mechanisms on the Conveyor-served Batch-type Benches so that Sub-assembly Operators (right) can supply either of Two Main-assembly Operators (left).*

be delivered by gravity conveyor direct to the stores from any of the machines lining the walls and handed out therefrom for subsequent operations. A factor which limits the scope of the layout in this instance is the fact that it is on the first floor of an old building, and consequently the heavier machines line the walls because of the added support provided there.

Product Layout

Great benefits have resulted from the policy of decentralization of certain machines to the specific department requiring the items produced on them, the aim being to make a department producing a certain range of jobs as self-sufficient as is economically advisable. A certain lack of balance and occasionally an idle machine is usually more than off-set by the flexibility provided by decentralization, since the sections are not separated geographically, and consequently it becomes the concern of one supervisor to produce the parts to feed his assemblers. Planning is thus simplified and "paper-work" reduced to a minimum. Fig. 5 illustrates a machine layout in order of product requirements for about 36 different components assembled later at the other end of the department. Work is discharged on to this second floor from a chain conveyor into the extension at the extreme left, and it is here that the sacks of work are emptied into standard trays, these then being placed on the gravity conveyor which moves them into the "rough" stores. Trays emptied by the assembler at the other end of the department are returned to the space provided in the extension.

Movement between the "rough" stores and first operations is accomplished manually, no trucks being necessary. The storekeeper stacks work which is in standard trays near to the point of the first operation, and the operators help themselves one tray at a time, placing it on a table at a comfortable unloading height at the side of the machine or process, and working from the full tray into an empty one placed on the other side of the machine. When this is full, it is stacked in the area provided behind the operators and is easily accessible for the next operation, when the procedure is repeated. On the completion of the last operation required on any component, the tray of work is placed on the gravity conveyor behind the row of machines, near the wall and is thus transferred to the central stores.

Finished-part Stores

The finished-part stores, which is mentioned again later, is approximately half the area that would have been necessary without the use of standard stackable trays. From here, work is handed out to the assembly benches twice a day and in order of bench placement. Components flow from operator to operator on these benches in the direction of the arrow (Fig. 5), the completed products at the last operation being placed into standard wooden boxes for despatch. The stillage on which these boxes are stacked is then moved by platform-truck to the despatch bay. The number of different products, their approximate batch quantities and minimum runs are shown. Since times and sometimes sequences of operations vary with the range of components, reserve side benches are provided that are by-passed by one or more of the components not requiring that particular operation. The main purpose of the conveyor belt is to move work from the comfortable discharge point of one operator to the hopper of another. It does not control the speed of operations.

Fig. 6 illustrates one of the inter-process mechanisms used on the conveyor-served batch benches for enabling either of the two sub-assembly operators shown on the right to keep either of two main assemblers supplied. Eight, shallow, triangular trays made from perforated aluminium sheet are supported by a vertical pin which passes through a bush fixed to the narrow end of each tray, enabling them to describe a full circle without fouling or being fouled by the others. The pieces held by these trays are precision parts liable to be easily damaged, and are therefore handled more selectively in this way.

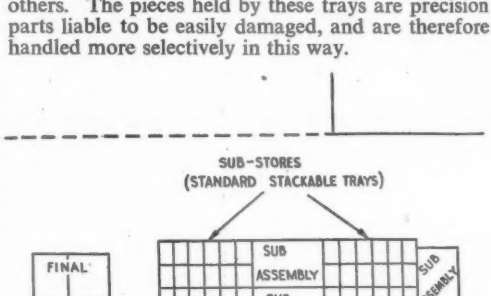

FIG. 7.—*Layout Illustrating the Manner in which Stacked Trays can serve as a Buffer Store of Work between Operations.*

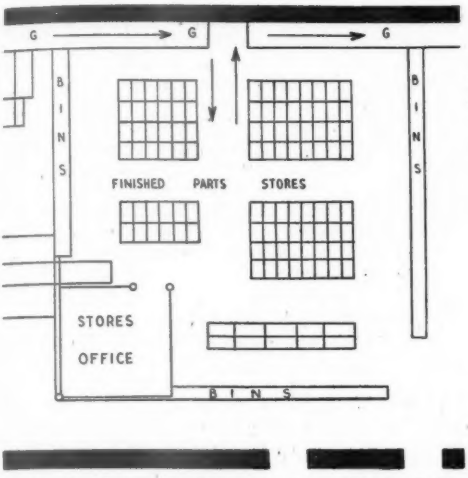

FIG. 8.—*Finished-parts Stores Layout, with Stackable Units in the Centre. (Part of Fig. 5.)*

General Movement

The special stillages shown earlier can be used successfully for inter-departmental movement as well as inter-process movement, the great difference being that it is possible to move the loaded stillages by fork-lift truck once they are on the ground-floor. Furthermore, the extended corner posts on each stillage enables the larger main stores to be built up by stacking the stillages. One idea which was suggested, was to load and off-load the stillages at the first-floor level directly by fork-lift truck, but the chain conveyor with hanging platforms for carrying sacks or trays now connects the floors at the end of the building, and being of the endless type can feed work in both directions and thus relieve the "bottleneck" created by the present inadequate lift.

Storage

Fig. 7, an enlarged portion from Fig. 4, shows how the standard tray can act, when stacked, as a buffer or headstock of work between operations; this being necessary on account of the different sizes of component involved. The department is one producing a range of components in a certain category, but of varying sizes and types involving the storage between operations of quantities of the various sub-assemblies. Twelve different sizes or types of component can be stored conveniently in this way between each operation, each type, if necessary, filling trays stacked two deep and six high. Fig. 8 shows the finished-part stores of the layout described earlier and comprises stackable units in the centre, with vertical shelving at the sides to create the stores boundary. These also serve the purpose of partitioning and of holding rapidly-consumable small parts, such as washers and screws. The main virtue of such a store is, of course, its flexibility since it can be extended or moved in a short space of time.

For movement of items from the machine-line conveyor to the appropriate stacking point, the storekeeper uses a small bogie-truck, shown in Fig. 9, which can transport comfortably trays stacked 6-high, and yet itself be carried back in one hand. The gangways between stacks of trays are consequently quite adequate at 3 ft. wide. On a reasonable floor-surface, bogies loaded with six trays can be moved quite easily over long distances, and have proved very useful as supplementary means of transportation in the production shops.

Despatch Section

Much time can be saved by packing components on the spot into standard, returnable boxes capable of taking known quantities of different components when packed scientifically. The despatch department is therefore concerned with the handling of one unit instead of over a hundred, and it has been found that customers who receive components packed in these boxes find them very convenient for their own storage.

Conclusion

That completes the case-study outlining the material-handling methods applied at a company engaged on batch production and "the results to date" appear to have been most successful. "Appear to have been" is used advisedly, because it is found impractical to measure accurately the exact savings resulting from improved material-handling. To begin with, it is a gradual process and the full benefits expected cannot be realized until the whole scheme is balanced throughout; and, furthermore, just how much of the increased output is due to intangible elements cannot be determined

FIG. 9.—*Small Bogie-type Truck which can Transport six Trays and yet is Light Enough to be Carried Back by Hand, 3-ft. wide Gangways being adequate.*

Transport and Storage

properly. The shops look tidy and efficient; the management are proud to take visitors around and output has increased considerably. These factors must have an effect on the operators, who may not consciously work harder although they work more easily, and the whole does seemingly result in an attempt to "match" efficiency with the appearance of the shops.

It must be emphasized that the cost of such a scheme is high, but, having taken the plunge, one finds that the reward is commensurate. In fact, although in this case the full scheme is not yet completed, the saving in cost has already paid for the installation and enabled the company to meet an increasing demand for its products. The throughput of the factory has increased by some 40 per cent. without the addition of a single square foot of floor-space and, furthermore, the labour force has not been augmented.

DISCUSSION

MR. D. E. BUTTERWORTH (Lancaster & Tonge, Limited) asked to what extent the Author had applied the system described to his foundry.

MR. WILSON replied that so far it was applied only on the engineering side, where about 200 people were employed.

MR. J. R. PARNELL (Parnell Brothers) asked what was the ratio of trays per operator.

MR. WILSON replied that that depended largely on what was being produced, and each organization had to find its own answer to the question. In his case, there were 6,000 boxes for 200 operators, and he supposed the cost was fairly high; he believed the boxes cost about 17s. 6d. each. So that it was necessary to spend some money to get a little back.

MR. L. W. GUMMER (Gummer's, Limited) referring to an illustration showing six trays on a small "skid," asked if a device was used which would take off the whole six, or whether they were taken off one at a time.

MR. WILSON said they were taken off one at a time, and stacked, but the design department was developing a simple device which would pick up a stack and thus do away with the little bogie.

Handling the Trays

MR. L. BUCKLEY (Newman, Hender & Company, Limited) recalled a reference to women operators handling boxes weighing 50 lb. or so, and asked for more information on that matter.

MR. WILSON replied that the weight of the boxes was 40 to 50 lb., depending on the components in them; the women picked them up and placed them by the side of their machines. They did not stack the boxes, for there were labourers doing that work.

MR. BUCKLEY commented that it seemed to be a heavy lift for a woman.

MR. GUMMER asked why the trays were not "palletized."

MR. RATTLIDGE said the whole point of the scheme was its flexibility and stressed that the scheme had been developed for batch production. In very few cases would there be a sufficient number of trays of one type of component to warrant a "palletized" load; in most cases, six trays stacked one on the other comprised just about enough of one form of component. There was no need whatever for a truck to move in the department. The work, in trays, was passed more or less from operator to operator and from machine to machine and, when completed, was placed on the gravity conveyor behind the machines which transported the trays to the finished-part stores. No expensive equipment was necessary for inter-process movement.

MR. T. H. WEAVER (W. & T. Avery, Limited) asked what was the annual figure for replacement or maintenance.

MR. WILSON replied that the system was put into operation just over 12 months ago, and he had not yet any figures with regard to replacements. Certainly the trays seemed to be standing up to the job very well indeed.

Alternative Types

MR. D. H. POTTS (Westinghouse Brake & Signal Company, Limited), invited an opinion as to whether an aluminium tray would have served the purpose.

MR. WILSON replied that the use of aluminium was not considered seriously because it was felt that that material was not strong enough for the job. In the hurly-burly of industry, any container that could be devised received a good deal of knocking about, and he did not think aluminium would stand up to it.

MR. P. W. COLLINS (Whyte & Collins, Limited) referred to some trays he had designed about two years ago for bronze foundry work, which were welded together. They were heavier than those described by Mr. Wilson, for they were made of 12-gauge material (approximately $\frac{1}{8}$ in. thick), and they had lasted very well. Nevertheless, in the foundry even those trays were roughly treated. Some 200 of them were made for transporting metal and metal mixes; they were not of the same shape as those of Mr. Wilson. He was afraid that, for foundry work, 16-gauge material would not be very suitable. Women did not handle the trays at his works, which might carry charges of metal weighing perhaps 120 lb.

THE CHAIRMAN, Major R. C. Watts, M.C., asked for the dimensions of Mr. Collins' tray, for the greater its size, the thicker should be the material of which it was made.

MR. COLLINS said it was about 18 in. long, 12 in. wide and about 5 in. deep, and there was a compartment, about 4 in. wide, on one side. The main part of the tray contained copper and the smaller division contained the tin plus other additions. His firm also made another type of tray, very similar to that described by Mr. Wilson, but without the handle.

MR. WILSON said he imagined that for foundry-work one would need to use trays very much stouter than those he was using, which were designed for the light engineering side of the works. When melting metal and making up heats, a very much stouter tray was used.

Permanent Ceramic Moulds for Non-ferrous Casting

*By D. E. Hope**

A process developed for producing small non-ferrous castings repetitively with a finish similar to die-castings but at a lower cost than that which embodies the preparation of a metal die.

With the present intensive development of new finished products by the engineering industry, most of which have to pass through an interim development or prototype stage, there is an increasing demand for castings with a finish usually associated with die-castings. Characteristics of this type of casting are good surface appearance, close dimensional tolerances, reduced machining requirements, and minimum of excess metal.

The production of a metal die entails considerable cost in labour, materials, and machine-tools, and the cost of such a die can only be recovered where the order is sufficient to give a reasonable production run. An order for a short run of 200 to 500 castings is too small to spread this die cost, particularly if it is for a prototype or limited production job for which a repeat order is not assured. Thus there is a natural reluctance to devote valuable tool-room capacity to such a project. In the majority of cases, therefore, these orders are diverted to the jobbing sand foundry, where a casting is produced which requires more finishing. Also, in view of the present shortage of skilled moulders, it is often necessary to make multiple patterns for mounting on a match-plate. Permanent ceramic moulds provide a comparatively new medium ideally suited to the requirements stated earlier. These moulds can be made using a conventional metal or wooden pattern and from each mould it is possible to obtain a hundred or more castings equivalent in finish and accuracy to die-castings. The moulds make no other demand on machine-tool capacity, and can be produced by unskilled labour, using the minimum of equipment and space. The only essentials are a reasonably efficient vibrator, special moulding boxes, and the use of an oven operating at temperatures up to 750 deg. C.

Mould Manufacture

Moulds can be made of any high-grade refractory filler, such as Zircosil, Molochite, or sillimanite. The binder used is a hydrolyzed solution of ethyl-silicate, such as Silester-O or Silester-A. The binder forms a silicic-acid gel, which bonds the filler particles with sufficient green-strength for handling, and after baking above 700 deg. C., forms a silica bond. The moulds have a low firing contraction, are free from warping or distortion, and very fine detail can be reproduced.

The method of manufacture is briefly as follows. The pattern is set-up on a plate (or in a plaster odd-side) to the correct parting line. Plasticine or plaster runners and risers are incorporated. After coating the whole thinly with a suitable parting medium, the first moulding box is assembled. The necessary quantity of refractory filler and the appropriate amount of hydrolyzed ethyl-silicate are then measured out, the setting time of the silicate being determined in a separate experiment. The binder fluid is added to the filler and vigorously mixed in, a note being made of the time. When the particles are thoroughly wet, the mix is transferred to the moulding box on a vibrating table, and the pattern covered to a depth of about 2 in. The time is checked and the operation completed within the setting time of the binder. The first mould is allowed to harden for about 90 min. before the plate or odd-side is

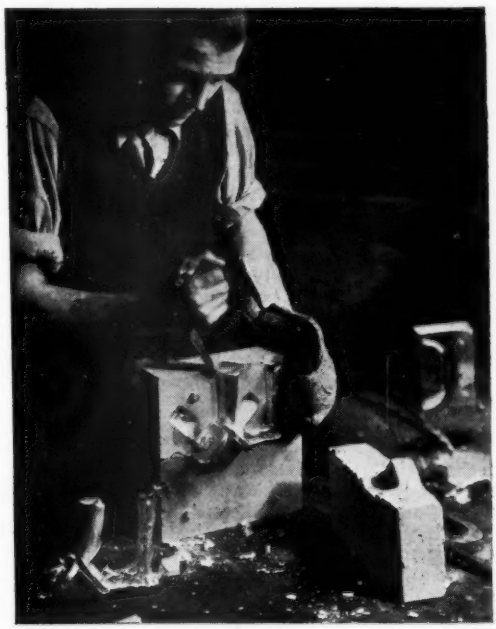

FIG. 1.—*Removing a Casting from a Permanent Ceramic Four-piece Mould at the Foundry of J. Stone & Company (Charlton), Limited. This Mould incorporated Expendable Cores.*

* The Author is associated with Monsanto Chemicals, Limited.

Permanent Ceramic Moulds

removed, and the second mould is then vibrated on to the first. When the whole has been allowed to harden, the mould can be stripped from the pattern and fired in the oven. In addition to the cost of the filler and binder, approximately 3 hrs.' labour, spread over two or three days, is required to make a simple two-piece mould.

Layout and Use

The mould layout should be arranged after the fashion of a simple gravity-die, and particular care should be taken in shaping runners and risers to obtain the maximum freedom of the casting in the mould from binding through metal contraction. Any hollow section should be provided with a removable core of the same material or with a conventional destructible core. The provision of metal handles through the back of the moulds assists ease of handling.

Before using, the moulds should be well heated by conventional means to suit the alloys concerned—250 to 300 deg. C. for aluminium alloys and 450 deg. C. for brass and bronze. Proprietary graphite or blacking mould-washes can be applied with advantage; it is even possible to dip the moulds in a graphite wash between casts. Casting rate can be speeded and overheating of the moulds prevented by casting several moulds in rotation.

Limitations

In order to obtain maximum benefit from the use of permanent ceramic moulds for casting, it is important to appreciate that there are limitations to their use. In this way, castings will not be attempted for which the process is unsuitable. Types of patterns which present difficulties are those in which small cored sections or corners are left unsupported. Castings with deep flanges set some distance apart are difficult to remove without damage to the moulds. The process is not suitable for repetition castings of steel or iron. It will be found, however, that the process is applicable to a large proportion of relatively simple castings in non-ferrous alloys which are always in demand, and up to 400 castings per mould have been successfully produced in aluminium.

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technological candidates equally with theoretical students. To assist in achieving a proper rationalization of all examinations, the creation of a Board of Metallurgical Studies and Examinations, to deal with matters not internal to universities, is proposed.

Operatives in the metallurgical industries are insufficiently responsive to the opportunities offered for education and technical training. The greater use of incentives towards the acquisition of education and training should be examined thoroughly and sympathetically and employers should take account of such achievements by their employees when considering promotions in operating departments.

Education and Training of Metallurgists

Further Recommendations of Joint Committee

Metallurgy is neither a pure science nor a purely intellectual pursuit. It is a technical and technological activity which is intended to provide things which are useful to mankind. Though many different occupations are involved in this pursuit, everyone who is engaged in any of them should be contributing consciously to the same end. The vocational instruction given to metallurgists must, therefore, be technological or simply technical.

A study of the education and training of metallurgists has been carried out by a joint committee formed from the major British metallurgical institutes and certain new recommendations have just been put forward.* Nothing has emerged from this recent survey to shake the committee's opinion that the universities are the chief source of high-grade metallurgical technologists, and it doubts whether any other source of equal value can be developed.

It is recommended that:—(i) University schools expand the output of technologists to the utmost of their ability; (ii) more university schools provide instruction in industrial science; (iii) education for management and administration be given in all university schools of metallurgy; (iv) opportunities for the contact of undergraduates with cultural and humanistic subjects be expanded.

The committee suggests that employers make the fullest possible use of post-graduate studies by financing the attendance of their suitable employees. It believes that more technologists are needed than the universities can supply. At present not all the leading positions can be filled by graduates; those unfilled, together with those of less eminence, demand an increased output of well-qualified men from the colleges of technology. A few of these colleges should be upgraded for the production of more high-grade technologists. The present standard of staffing the colleges should be raised; no other improvements in conditions will be worthwhile unless this is done. The White Paper, Cmd. 8357, states that "increased financial assistance should be given to the colleges engaged in advanced technology."

Employers are recommended to collaborate actively with the colleges of technology in devizing courses, facilitating the attendance of their employees, and allowing members of industrial staffs to participate in the teaching of suitable subjects.

The committee also recommends that the whole of the examinations in metallurgy for non-university students be rationalized. It believes that corporate membership of one of the professional, metallurgical institutions (generally the Institution of Metallurgists) should be the ultimate goal for technological pupils in metallurgy, and suggests that such changes be made in the requirements of these institutions as would fit their examinations to

(*Concluded at the foot of Col.* 1)

* "The Education and Training of Metallurgists," by the Joint Committee on Metallurgical Education (September, 1952). Copies of the 56-page Report are obtainable from the Committee Secretary, 4, Grosvenor Gardens, London, S.W.1.

Internal Stress in Castings*

Discussion of the Report of Sub-committee T.S.32

This Report had been prepared by the Sub-Committee as an interim measure to assess general interest and to obtain comments on the procedure adopted and results to date. The lively discussion, which is reported below, provided a generous measure of approval for the work and added points for detail consideration, particularly concerning light alloys, pouring temperatures, cooling methods and the effect of mould materials. Examples were quoted of the results in practice of conditions of internal stress in particular castings, and additional work on high-temperature effects was reported. Finally, a theory to explain delayed cracking was expounded.

Opening the discussion, MR. D. C. G. LEES said the Sub-committee defined internal stresses as being those " which remain in a casting after it has been removed from the mould," going on to remark further that they " arise during casting and subsequent cooling." It was noted that restraint of contraction due to the pressure of sand led to hot-tearing, distortion, and other defects, and that temperature differences within the casting might lead to cold cracking. In these ways, the internal stresses might be eliminated but at the cost of the integrity of the casting.

Mr. Lees was interested to read that some of the initial work was carried out with flanged, horizontal bars run from the centre, because he had used the same principle in studying the hot-tearing of aluminium alloys. In subsequent work, flanged bars were cast in dies. The Sub-committee confined its attention to changes brought about by the mould and it was perhaps worth mentioning that the grain-size of the metal was found to have a marked effect in controlling the tendency of cast aluminium alloys to show hot-tears when contraction was restrained. It was well known that fine-grain materials had a lower resistance to creep at high temperatures and in this way one could readily understand how (*a*) they were less prone to hot-tearing, and (*b*) any internal stress in them might be smaller than in coarse-grain castings. In other respects, too, and notably as regards strength and ductility, fine-grain size was to be preferred. To what extent those remarks applied to other cast metals he could not say; with aluminium and magnesium, at any rate, the control of grain size was now well understood.

Choice of Alloy

The triangular grid casting shown in Fig. 3 of the Paper typified the kind of design where internal stresses might be developed owing to the quicker cooling of lighter sections. He was disappointed that for some of these experiments RR.59 alloy had been chosen. This was an alloy mainly used in the form of heat-treated stampings; there was no doubt that it could be cast quite readily, but he thought it would have been more appropriate to use a similar alloy such as RR.53 (LM15 in BS.1490) which had similar mechanical properties but which was a foundry alloy. Some of the results quoted were understandable, as for example, the effects of time before stripping and of the moisture-content of the mould; he also saw reasons for the effect of the runner size. He suggested that the pouring-temperature effect needed further study, care to be taken in correlating the results with any effects on grain size. Only two points were given in Fig. 4 and, particularly in the absence of details on the methods of measurement employed, he suggested that these did not justify the drawing of a straight line.

Solution-treatment

Internal stresses could be developed after stripping from the mould, particularly as the result of differential cooling during quenching. This could affect aluminium-alloy castings, because rapid cooling from the temperature of solution-treatment was necessary, and it could no doubt occur in steel. It would be valuable for the Sub-committee to consider this matter, recalling that solution-treatment was very often followed by a fairly lengthy precipitation-treatment at (say) 170 deg. C. and that a stress-relief anneal at 250 to 300 deg. C. was also given when extreme dimensional accuracy was needed.

Mentioning the creep resistance of the alloy itself, Mr. Lees said he was not competent to speak of the steel used in the experiment, but the aluminium alloy used was one based on the famous " Y " alloy, and which like its very illustrious ancestor, had a high resistance to creep at temperatures such as 300 deg. C. That the Sub-committee recognized the importance of this matter was shown by their curves in Fig. 1, and Mr. Lees emphasized that with the aluminium/silicon and aluminium/silicon/copper alloys which were so widely used, the creep resistance at (say) 300 deg. C. was very much lower, so that under identical conditions any internal stress would be of a much lower order than those shown in Fig. 4 and Table I. It was noteworthy that Thorpe, Tremain and Ridley of the National Physical Laboratory published a paper in 1950 describing *inter alia* tests in which an aluminium bar was held in a rigid steel framework and the whole heated up to 400 deg. C. and allowed to cool slowly. Stress might be developed during both heating and cooling and he wished to emphasize that the aluminium/copper/nickel/magnesium alloys, the descendants of Y-alloy, cracked fairly readily, whereas a more-easily-yielding aluminium/silicon alloy was unaffected after a number of cycles of heating to 300, 400 or even 500 deg. C.

* Report printed in the JOURNAL October 23; at the Buxton Conference of the Institute of British Foundrymen it was presented by Mr. M. M. Hallett, M.Sc., F.I.M., chairman of the Sub-committee, with Mr. E. Longden, senior vice-president of the Institute, in the chair.

Internal Stress in Castings—Discussion

Reason for Alloy Choice

MR. HALLETT said he was sure the Sub-committee would welcome Mr. Lees's extremely helpful comments. He had drawn attention to the grain-size effect in aluminium alloys which was normal and understandable. In the report the Sub-committee had dealt only with the conditions giving rise to internal stresses. They had not considered steps which could be taken to overcome the effect of internal stresses. Mr. Lees was quite right in pointing out that the fine-grain alloys might be much less prone to the development of internal stresses than those of coarse grain. As a foundryman, he was also quite right to point out that RR59 was not a normal foundry alloy. The reason for its choice was that some of the work was done at Birmingham University by Dr. Dodd, who was carrying out a general investigation into the effect of internal stresses in a wide variety of materials in many conditions. He had used RR59 as a generally applicable aluminium alloy. It had the advantage, as Mr. Lees had pointed out, of good properties at high temperature and a high yield stress and, therefore, readily developed high internal stresses, making it a suitable alloy for experimental purposes. Incidentally, Dr. Dodd had reported on part of his work on continuous-cast bars of RR59 alloy in the April, 1952, *Journal of the Institute of Metals* and anyone interested should refer to that paper.

In reply to the comments on effect of pouring temperature, it was unfortunate that there did appear to be only two points on the graph in Fig. 4, section C. There were in fact five pouring temperatures studied, as would be seen in Table I, section B, and those five temperatures formed the basis of Fig. 4, section C. The Sub-committee agreed that further work was needed on the effect of pouring temperature. The other point he would emphasize was that that work was preliminary and tentative and they would not like to be criticized too severely on the apparently small amount of experimental work. Their conclusions were preliminary and merely intended to clarify the position.

Stresses after Cooling

Mr. Lees also raised a very important point in the possible development of internal stresses during cooling after stripping from the mould. It also applied to stress-relief annealing operations. No purpose was served by heating a casting to some temperature which relieved the whole of the stresses and then cooling the casting rapidly under conditions in which further temperature differences were set up, because more internal stresses might then be put back into the casting than it had started with. The job had to be cooled under such conditions that temperature differences did not develop.

Position Summarized

MR. T. R. TWIGGER suggested that one of the reasons for presenting a report at an early stage in the Sub-committee's work was to enable the Sub-committee to get some guidance as to the amount of interest in the work being undertaken and to obtain suggestions as to the direction which further work might take. Personally he welcomed the report, although he realized it was a little premature. He thought that a word or two on its background might be added. A year or two ago there were a number of papers dealing with the relief of internal stresses by heat-treatment, and that work was taken to the point where the release of internal stresses by heat-treatment was considered to have been adequately covered. Subsequent work then moved in the direction of finding the effect of heat upon artificially-applied stresses. In commenting upon that work, he expressed the opinion that little had yet been done to assess the magnitude and location of internal casting stresses. He thought that the present report showed the beginning of valuable work in this direction. The practical position seemed to be that one must either learn how to avoid residual casting stresses or remove them by heat-treatment. It was interesting to note from the report that residual stresses could only be caused at low temperatures. At higher temperatures they just did not exist.

He thought that future work would probably have to be directed largely to temperature equalization, even if it was difficult to see how this could be applied in practical foundrywork, except on very broad lines. In spite of any such difficulties he thought the work should be continued, and he wished the Sub-committee every success.

Value of Chairman's Work

MR. HALLETT agreed with what Mr. Twigger had said that he thought the Sub-committee would be fortified by such approval of their general line of attack on the problem. Their present chairman, working on large castings, had shown how one could reduce internal stresses by such means as directing cooling air carried in suitably-arranged ducts to the hotter portions of a casting. That was entirely an internal-stress effect and was a practical application of the principle of reducing temperature differential between one part of a casting and another.

He should mention that although they had tended rather to emphasise the temperature-distribution effect, because they believed it was the least generally appreciated, they were also studying effects due to the sand mould and its restraint more fully than was covered in the present report.

MR. J. DEARDEN said the Sub-committee were to be congratulated on clearing the air in what was a rather mysterious subject. All stresses were internal, even when caused by an externally-applied load, and he thought it would be preferable to use the term "residual stresses" for those remaining in a casting after cooling to room temperature.

He agreed with the Sub-committee's main conclusion that it was the unequal rates of cooling which created residual stresses. It had been stated that residual stresses could be minimized by removing a casting from the mould while still hot, and allowing it to cool in air. Did this also apply in the case of stress-relief annealing, in which it was usual to cool slowly in the furnace?

He thought that three principles could be enunciated in connection with residual stresses in castings:-

(*a*) The portion of the casting last to cool always finished in a state of tension; (*b*) the presence of distortion in a casting signified residual stress which had been only partially relieved by the distortion which occurred; and (*c*) the absence of distortion was not necessarily proof of the absence of residual stress, because the rigidity of the casting might have prevented distortion.

Residual stresses could arise in two ways:—

(*a*) Those caused by unequal cooling of different sections or portions of frames, grids, rings, or cylinders, and (*b*) those occurring within any individual section due to the interior cooling more slowly than the outside, and therefore producing tension at the centre, and compression at the outside. He would be interested to know the Sub-committee's views on the relative importance of these two classes.

Residual or Internal Stress?

MR. HALLETT thought Mr. Dearden's comments very much to the point. He was probably right in saying that the term " residual stresses " was better than " internal stresses." The Sub-committee had discussed that point at considerable length, but standardized on the term "internal stresses" because they felt it was the one most commonly used not only in the foundry, but in literature generally.

On the question of furnace cooling or cooling in air, the principle to observe was that the rate of cooling had to be such that the temperature difference between any one part of the casting and another was kept at a minimum. In the case of a stress-relieving operation, carried out as a result of heating in a furnace, he was sure there would be less stress by cooling in the furnace, because the whole of the casting being cooled would maintain very much the same temperature. If it were pulled out and allowed to cool in the air, the thin parts would cool more quickly and the thick parts less quickly, leading to temperature differences which caused internal stresses. In the case of the Sub-committee T.S.18 report, which dealt with the effect of stripping temperature, it was shown that in the triangular-grid casting it was better to strip the casting from the mould at a high temperature.

In the bottom section of Table I of the report under discussion, it was indicated that an ordinary 0.3 per cent. carbon steel developed an internal stress but 3.75 tons per sq. in. when stripped at a high temperature. The three corresponding castings stripped after cooling in the mould for 24 hr. all showed stresses of 10 to 15 tons per sq. in.—about four times as great. The reason was that, in the mould, temperature differences were usually set up so that the thick parts were hotter than the thin parts, a condition established at a relatively high temperature. The hot regions were embedded in correspondingly hot sand.

If one took that casting from the mould, it was removed from the effects of the hot sand around the various parts. The removal of the sand allowed the casting to cool freely so that the thick sections started cooling very much more quickly than the thin section, and by the time the dangerous temperature was reached the thick section had gone a long way towards catching up in its rate of cooling with the thin section. The effect was to reduce the temperature difference and thus the amount of internal stress.

Three-dimensional Nature of Stresses

He thought Mr. Dearden's principles were pretty accurate. Generally speaking one would expect the hotter section to show finally a tensile stress, but it must be borne in mind that stresses occurred in three directions and a tensile stress in one direction might not correspond to a tensile stress in other directions. Distortion was one of the manifestations of internal stresses and usually arose from stresses which had developed at relatively high temperatures. Hot-tearing was a manifestation of more severe stresses developed at high temperature. Internal or residual stresses left in the casting at room temperature were a less-obvious manifestation and the absence of distortion was certainly no proof that internal or residual stresses were absent.

Mr. Dearden had finally referred to the possibility of internal stresses arising in an individual section such as a test-bar casting. He would doubt whether the internal stresses were likely to be very marked because there was not a very big temperature gradient across a cooling test bar. There was a much bigger gradient in a hollow cylinder cast around a core because the core retained heat and kept the bore of the cylinder at a much higher temperature than the outside. That did not arise in the case of a solid bar. He would refer again to the T.S.18 Report which showed some cooling curves of the temperature distribution across bars 2 in. dia. The maximum temperature difference across that casting was only of the order of 10 deg. C., so on that ground he would not expect very marked radial stresses inside a solid bar.

Non-uniform Structures

MR. REYNOLDS mentioned an experience concerning the effect of accidental inclusions of unstable elements in cast-iron mortar-millplate. He was making the mortar-mill plates from an all-scrap mixture; each weighed about 10 cwt. and was 3 in. thick. The practice was to remove the casting from the mould the following morning. As soon as an attempt was made to knock off the risers, the casting flew into five or six pieces and showed a white-iron fracture, although an analysis showed that the silicon content was between 2 to 3 per cent., which should have given a very soft casting. The job was made of cast-iron and steel scrap (some of the latter being galvanized). Whether it was the boiling of the metal in the ladle due to volatilisation of the zinc that caused the structure to be white he could not say, but he thought the example might be of interest. No zinc was present according to the analysis of the casting and he presumed it had been evolved in the form of zinc oxide.

Another experience was with fairly thin, box-shaped iron castings. When first they were made, they were cast with a core and allowed to cool in the mould. After stripping, it was found that they cracked, particularly where there were windows in

to accommodate other components. When the top box was taken off and the large core relieved, the castings were found to be cracked, even when left in the mould. The final solution arrived at, was to remove the top box, relieve the core and then replace the top box, carrying out the whole operation as quickly as possible so as to allow as little cold air as possible to reach the casting. Those parts were still being cast successfully in that manner.

Mould material could have a big effect on contraction, stresses and camber. When a dry-sand core (oil-sand or naturally-bonded sand) was used, one was apt to get cracked castings in aluminium. When a green-sand core was used the cracking ceased. His conclusion was that one could have contraction trouble by unsuitable metal, and one could have trouble due to the varying resistance of mould and core materials to contraction stresses.

MR. HALLETT thought Mr. Reynolds' comments practical and welcome to the Sub-committee.

It was extremely difficult to analyse any given case unless complete information was available and he would not like to be too definite in replying to Mr. Reynolds. Without considering whether the whiteness of the fractured mortar-mill plate casting was due to a reduction in the total carbon or to the zinc or to some other element introduced at the same time as the zinc, it was reasonable to suppose that the white iron with its higher modulus of elasticity would show higher internal stresses as a result of any given strain. Changes in the metallurgical characteristics of the material being handled might affect most profoundly the amount of the internal stresses.

Similarly with the box-shaped castings he would not like to be very definite in his comments. Possibly Mr. Reynolds might like to give them some more detail which the Sub-committee could consider They had to differentiate, as he had pointed out, between hot tearing and internal stresses. There was no doubt whatever that a hard mould would cause hot-tearing. The hard mould would also influence the amount of internal stress but Mr. Reynolds' cases might be straightforward examples of what was essentially hot-tearing arising from the mould condition. A much more detailed account would be required before a really accurate answer to Mr. Reynolds' comments could be given, but they were welcome because the Sub-committee was very anxious indeed to have quoted to them examples in the foundry of internal stresses which they could think about and study.

Stresses at High Temperature

MR. J. W. GRANT had been surprised to find that so much emphasis had been put on residual stresses almost to the exclusion of internal stresses which came after solidification. Those internal stresses were extremely important. Mr. Hallett had referred to hot-tearing which was the extreme case of internal stresses caused soon after solidification, but he (the speaker) suggested the Sub-committee should consider cases, not only where the stress had been so great as to cause failure, but where it was great enough to cause some damage to the cast iron.

Mr. Hallett had said that at a high temperature there were no internal stresses. That was not strictly true, because there were internal stresses in hot castings, as he was sure would be admitted. An important consideration was the value of those stresses compared with the ultimate stress, and the strain which was caused. If that strain came near to causing failure, then, surely, there was some damage to the cast iron, and when the casting reached room temperature there might be no residual stress at all but the iron might have been damaged. He had carried out some experiments where a cast iron had been taken into the red-hot temperature range, stressed and cooled to room temperature. That treatment was comparable with the stresses formed during casting, and by repeating the treatment some five or six times the ultimate strength at room temperature was reduced by some 20 to 30 per cent., and the strain which it was capable of withstanding had been halved.

MR. HALLETT made three points in reply to Mr. Grant's comments. First, he was not able to alter the terms of reference of the Sub-committee, which were to deal with internal stresses in castings and not to consider hot-tearing. Secondly, there was no doubt that it had not been made sufficiently clear that the stresses imposed while the casting was cooling at high temperatures might affect profoundly the amount of internal stress found in the casting when ultimately it was studied at low temperatures. Thirdly, the damage suffered by the iron as a result of stresses imposed on it at high temperatures represented a very interesting and important point about which extremely little was known and he thought the work to which Mr. Grant had referred was almost the only reference in available literature to any such effects. He imagined that what Mr. Grant had in mind was the damage which was manifested as a strain. There must be some opening-up of cracks, on a microscopical scale, which influenced the resulting strength of the iron at low temperatures. It was somewhat akin to the changes which occurred under fatigue conditions. In the early stages of fatigue, the changes were very difficult to detect and follow, but undoubtedly affected the ultimate result.

MR. GRANT added that when the central member of the casting was cut, it would then be free from internal stress, but it would already have been strained, when hot in compression and when cold in tension, similar conditions to which he had already made reference. Would it not be possible to compare the properties of the central member of the casting after its stresses had been removed by sawing through one end, with a similar bar from another casting cast with only one end connected to the side pieces, so that internal stresses would not develop?

MR. HALLETT said he saw no reason why Mr. Grant's suggestion should not be followed. The Sub-committee's technique was to apply strain-gauges to the central member. Readings had been noted on the movement of the strain-gauges and

calculated as internal stresses, but it would be a little difficult to separate the effect of the internal stresses superimposed on a normal tensile test from the tensile strength deterioration due to the effect of the internal stresses at a higher temperature. However, he thought the experiment might very well be considered and an effort made to carry out the experiments in parallel.

Delayed Cracking

MR. W. J. COLTON said the report emphasized the effect of differences in temperature but, since this was preliminary work and further work was in progress, any discussion could only be on a limited scale. However, he thought that there was one category of cracking resulting from internal stresses which so far had not been mentioned, namely, the instance of an apparently sound casting cracking at some time after manufacture. The usual explanation given for such an occurrence was that the casting was in a sufficiently high state of stress that changes in ambient conditions were such as to impose sufficient additional stresses to cause failure. The type of castings in which this category of cracking had been noticed was a tubular casting with a flange at each end.

Although the question of hot-tearing was not in the terms of reference of the Sub-committee, mention had been made of this phenomenon, and he was in agreement with the point of view that hot-tearing was the result of stresses imposed at high temperature, but that castings showing this defect did not necessarily contain undue residual stresses subsequently.

He was very pleased to see that the effects of moulding sands were to be included. He agreed that the differences in ramming-density of the sand, surface hardness and hardness in depth of the mould could give a great deal of trouble, particularly in producing hot-tearing, distortion and, most probably, residual stresses.

With regard to the question of castings which cracked some time after they had cooled, MR. HALLETT said that the Sub-committee did not really know the answer. The best explanation that could be given was the one put forward by Mr. Colton. A casting which cracked in the fettling-shop, or when lying in stock in an apparently sound state, must have a high residual stress in it resulting from the cooling conditions in the mould or the cooling conditions right down to room temperature. One would imagine that the residual stresses would approach the tensile strength. On that internal stress must then be imposed some further stress which might be due to careless handling or to some change in temperature. It was significant, he thought, that many of the cases of castings which cracked in this manner occurred in cold weather, or after the castings had been exposed to cold winds. In other words, the only explanation which he could give at the moment was that, when superimposed on to an already highly-stressed casting, some small temperature difference resulted in the critical stress or tensile strength being exceeded.

Blast Furnace Relined in 24 Days

World Record Time

The No. 9 blast furnace at the Appleby-Frodingham Branch, Scunthorpe, of the United Steel Companies, Limited, was re-lit last Monday after relining in the world record time of 24 days.

The furnace was taken off blast on September 27. During the next five days rainfall was very heavy and high winds, sometimes of gale force, were blowing, making the work of top stripping increasingly difficult. Not only had heavy weights to be raised, but the men were working at heights up to 180 ft. above the ground.

During the first 36 hours after the furnace came off blast 426,000 galls. of water were put in to cool down the contents. As soon as the water was turned off demolition started, and by October 3, 1,400 tons of old burden, bricks, and rubbish had been carted away. The total amount of rubbish removed from the furnace was something of the order of 3,000 tons, in addition to several hundred tons of steelwork that had been dismantled and removed.

A Combined Operation

Careful planning and the ingenious use of existing machinery ensured that the job went smoothly. At the peak period, 150 men were engaged, working day and night under sometimes deplorable conditions.

Special railway lines were laid and the skips normally used for charging the furnace with coke and ore were utilized to take away old burden and bring up new refractory brickwork. The hearth and bosh of the furnace have been lined with carbon blocks and the rest of the stack with refractory bricks. At the same time, the furnace hearth was extended from a diameter of 22 ft. to 25 ft., and it is estimated that this increase in size will produce an additional 600 tons of pig-iron weekly on top of the normal 3,800 tons.

On the last occasion the furnace was relined (1946) the job was accomplished in 56 days, while its sister furnace (No. 10) was relined several years ago in 43½ days. The latest time taken of 24 days gives a saving of 96 days on the existing national average for this type of job of four months, or 120 days.

Basing the furnace output now that the size has been increased on 4,400 tons weekly, or a low average of 600 tons daily, in the 96 days' working time that has been saved an additional 58,000 tons of pig-iron has been made available.

CUBAN MINERAL EXPORTS in the first nine months of 1952 amounted to $8,900,000, compared with $5.100.000 in the same period last year. The increase in the value of manganese exported was most noticeable ($2,800,000 over $1,300,000); copper showed a smaller increase ($3,600,000 over $3,200,000). The completion by the National Development Commission of an electricity plant in the Isle of Pines is expected to result in the reopening there of a gold and a tungsten mine. The Cuban Government has acquired rights to utilize the Thomas Swan concentrating process for nickel and manganese-bearing ores and a pilot plant is to be erected to test it.

Lloyd's Shipbuilding Returns

Lloyd's Register Shipbuilding Returns for the quarter ended September 30, and relating to merchant ships of 100 tons gross and upwards, show that steamships and motorships under construction at the end of September totalled 343 ships of 2,062,482 tons, a decrease of 13,759 tons compared with the previous quarter. Of the total, 102 ships of 528,457 tons were fitting out afloat and 241 of 1,534,025 tons were still to be launched. The ships under construction included 123 steamers of 872,935 tons and 219 motorships of 1,189,447 tons. In the remainder of the Commonwealth there were being built 20 steamers of 150,335 tons and 18 motorships of 37,472 tons. Oil tankers under construction in Great Britain and Northern Ireland comprised 100 ships of 1,149,476 tons, an increase of 18,990 tons compared with the previous quarter. The number of steamers being built throughout the world totalled 325 of 2,533,161 tons and 876 motorships of 3,330,814 tons, making a total of 1,207 ships of 5,864,873 tons compared with 1,190 ships of 5,614,183 tons in the June quarter.

Work in hand in the principal districts of Great Britain and Northern Ireland is shown in Table I.

TABLE I.—*Work in Hand in Principal Districts of Great Britain and Northern Ireland.*

District.	September 30, 1952.		June 30, 1952.		September 30, 1951.	
	No.	Tons gross.	No.	Tons gross.	No.	Tons gross.
Aberdeen	20	31,471	18	23,171	11	9,012
Barrow	4	74,389	4	74,550	5	85,300
Belfast	22	228,900	20	209,790	24	252,200
Bristol	6	2,330	4	1,630	4	985
Clyde { Glasgow	76	504,972	82	524,630	97	604,743
Clyde { Greenock	31	229,897	31	230,400	31	243,220
Dundee	7	52,160	6	47,160	8	53,100
Hartlepool	9	46,530	9	50,780	9	48,000
Hull	39	14,449	39	14,788	36	14,342
Leith	14	36,707	15	42,354	18	34,917
Liverpool	15	105,330	17	124,030	15	109,895
Middlesbrough	15	161,166	16	157,536	14	146,541
Newcastle-on-Tyne	39	360,363	39	373,610	42	428,295
Southampton	9	8,138	8	7,718	10	11,478
Sunderland	30	203,348	29	192,005	31	225,417

Iron-ore Imports

Imports of iron ore in September and the total for the nine months of the year to date, with comparative figures for 1951, are shown below.

Country of origin.	Month ended September 30.		Nine months ended September 30.	
	1951.	1952.	1951.	1952.
	Tons.	Tons.	Tons.	Tons.
Sierra Leone	42,005	54,313	418,025	579,791
Canada	107,902	75,700	422,259	539,192
Other Commonwealth countries and the Irish Republic	10,857	901	28,081	17,923
Sweden	324,594	306,579	2,544,022	2,734,219
Netherlands	7,141	6,198	34,689	31,216
France	26,483	40,244	275,772	316,921
Spain	45,979	46,404	602,325	544,115
Algeria	107,835	150,374	1,067,608	1,300,304
Tunis	37,350	63,100	371,524	432,559
Spanish ports in North Africa	33,800	21,625	262,030	214,267
Morocco	12,914	14,700	206,867	232,769
Other foreign countries	35,869	50,215	158,612	382,430
TOTAL	792,729	830,353	6,391,814	7,325,706

Shotton Works Contract for Head, Wrightson

A contract has been awarded by John Summers & Sons, Limited, Shotton, Chester, to Head, Wrightson & Company, Limited, Thornaby-on-Tees (Yorks), for doubling the pig-iron output of the plant at present under construction. The company is at present completing construction of a plant for John Summers & Sons at Shotton for the anticipated production of approximately 1,000 tons of pig-iron per day. This integrated plant covers the entire range of iron-making equipment from ore unloading, crushing, and screening through sintering to a complete blast-furnace plant with gas-cleaning equipment and special rolling stock.

The new furnace plant will be a duplicate of the one nearing completion, which is one of the largest blast furnaces outside the United States.

Rise in Sheffield's Steel Output

During September, steel firms in the Sheffield area produced nearly 48,000 tons of crude steel a week, making the weekly average so far this year better than for the same period or the whole of last year. Sheffield has also risen to third place among the nation's producers of crude steel ingots and castings.

Figures for August show that though the average for the first eight months of the year is 2,000 tons a week less than last year, the City's production of 13,300 tons a week of prime and second quality semi-finished steel was better than in July or last August. Sheffield still holds the lead in the production of prime and second quality semi-finished steels.

Institute of Metals' Officers

Prof. F. C. Thompson has been elected president of the Institute of Metals for 1953-54 and will take office at the 1953 annual meeting. New vice-presidents elected, also with effect from the 1953 annual meeting, are Major C. J. P. Ball (chairman, Magnesium Elektron, Limited) and Prof. G. V. Raynor (Professor of Metal Physics, University of Birmingham). Prof. Thompson is Professor of Metallurgy in the University of Manchester.

The council of the Institute has elected Dr. S. F. Dorey (Chief Engineer Surveyor, Lloyd's Register of Shipping) to serve as senior vice-president for 1953-54, and he will be the council's nominee for the presidency in 1954-55.

U.K. Link with Schuman Plan

The British mission to the High Authority of the European Coal and Steel Community has decided to set up a joint committee to ensure close collaboration. Led by Sir Cecil Weir, the British mission arrived at the community's headquarters in Luxembourg last month, having been set up by the Government soon after the establishment of the High Authority in August.

The joint committee will be composed of the president, members, and officials of the High Authority, and leaders of the British mission. Its first meeting will be held in Luxembourg in the week of November 17.

Sand-cast Beryllium-bronze*

Further Discussion of the Paper by Mr. L. Grand

MR. J. T. RICHARDS, development engineer, and MR. E. M. SMITH, metallurgist, of the Beryllium Corporation, Reading, Pennsylvania, wrote that the Author had made an important contribution to the available data on beryllium-copper sand castings; however, there were several points that merited further consideration:

1. Although it was stated that nickel or cobalt additions were not necessary in casting alloys, these additions were helpful in controlling the degree of solubility of the alpha phase during solution treatment (observable after precipitation hardening). Furthermore, small additions of nickel or cobalt (0.15 to 0.35 per cent.) stabilized the age-hardening curve, so that it was less critical with respect to time. It was the writers' opinion that cobalt was more effective than nickel, both as a grain-growth inhibitor and as a stabilizer.

2. In considering the Author's Figs. 2 and 3, there was some question as to whether the amount of beta phase had really been substantially reduced by treatment at 800 deg. C. As indicated by Fig. A, the beta phase might contain extensive alpha entrapments, which could be removed by an effective solution-treatment (see Fig. B). In addition, a complete solution-treatment, such as applied with the effect shown in Fig. 3 or Fig. B, tended to produce more spheroidal or regular boundaries for the beta phase.

3. If heat-treatment were continued beyond the optimum period (averaging), the gamma phase was not absorbed in favour of the alpha phase but was further precipitated as the alpha matrix became depleted (Fig. C). The softening noted resulted from the lower inherent strength of the matrix and the particle growth of the precipitated gamma phase. It was necessary to heat above the eutectoid temperature to transform gamma into beta or to heat above the solvus temperature (approximately 760 deg. C.) to eliminate gamma in favour of alpha.

Temperatures and Impurities

4. On the basis of the writers' experience, it was felt that the solution-treatment and age-hardening temperatures cited were low. For an alloy nominally of 2.0 per cent. beryllium plus 0.3 per cent. cobalt, the writers' practice was to quench in water after three hours at 800 to 815 deg. C. followed by aging for three to four hours at 645 deg. C. Of course, with a binary alloy, it was possible that this latter treatment might prove too high. Perhaps the most important consideration for solution annealing was to select a temperature that insured maximum solubility.

5. The writers had not found that aluminium impurities were as deleterious as indicated in Table IX. In commercial beryllium-copper alloys for sand casting, aluminium could range up to 0.15 per cent. or even higher without effect.

6. Many of the tensile and hardness properties presented appeared to be low. For example, a commercial sand-casting alloy (nominally 2.0 per cent. beryllium) had a minimum Brinell hardness of 352 and averaged 393. Ultimate tensile values

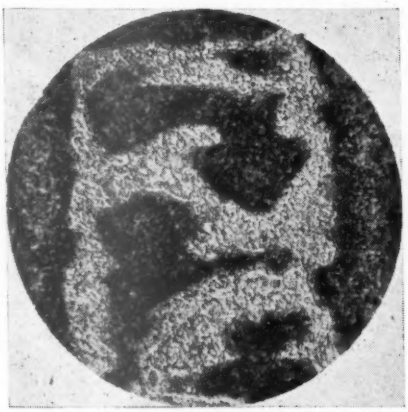


FIG. A.—*Typical Dendritic Beta-phase Constituent (light mottled area) showing Alpha entrapments in Beta crystals.* 750 ×.

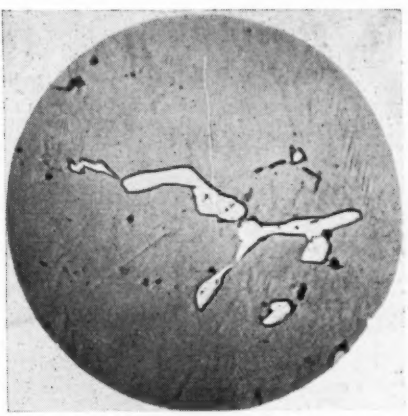


FIG. B.—*Same Structure as shown in Fig. A after Solution-treatment for 3 hrs. at 815 deg. C. and Quenching in Water. (The apparent decrease in Beta-phase results from the solution of the entrapped Alpha-phase and the concurrent re-orien-Beta into Alpha plus Gamma.* 1,500 ×.

* French Exchange Paper presented by L. Grand to the Buxton Conference of the Institute of British Foundrymen (June, 1952) and printed in the JOURNAL, September 18.

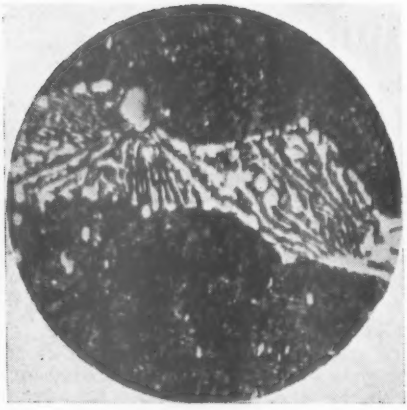


FIG. C.—*Typical Averaged Structure of the Alloy (8 hrs. at 540 deg. C. and air-cooled) which shows heavy precipitation of Gamma-phase from the Alpha matrix. The White Spheroids in the dark background represent an advanced stage of Gamma-particle growth and the Pearlitic Structure results from Eutectoid Transformation of Beta into Alpha plus Gamma.* 1,500 ×.

ranged from 67 to 83 tons per sq. in. The hardness of an alloy nominally containing 2.7 per cent. beryllium ranged from 393 to 460 Brinell.†

The specimens shown in the accompanying photomicrographs were prepared by etching with an ammonia persulphate hydroxide solution.

† "Beryllium-copper Sand Castings." J. T. Richards, *Foundry*, vol. 79 (Aug., 1951), pp. 90-93, 241, 244, 247, 248, 250-256.

Author's Reply

MR. GRAND wrote in reply that (1) Mr. J. T. Richards and Mr. E. M. Smith had referred to the influence of nickel on the grain-size which he (Mr. Grand) had been unable to observe. A personal opinion was that the macrographic structure of sand-cast beryllium-bronze carrying 0.3 to 0.4 per cent. of nickel was essentially a function of the casting temperature. It became coarser when the metal was cast at a high temperature.

As to the influence of nickel and cobalt on the stability of the mechanical properties, as a function of the time of the tempering treatment, the Author had so far been unable to study this particular phase. He had shown simply that the properties were comparable, all things being equal, according to whether the alloy had or had not had a nickel addition. This being the case, he had not gone deeply into the question, since the presence of this element (or of cobalt) applied more particularly to the case of rolled brass.

On the second point, Figs. 2 and 3 of the Paper gave details of a provisional character of the average appearance of a large number of samples seen under the microscope. It was shown to be quite difficult to dissolve the β constituent and practically impossible under industrial conditions to do so completely. It had been pointed out, however, that in most cases distinct progress had been made to effect solution when the temperature exceeded 720 to 800 deg. C. On no occasion had the inclusion of the α phase in the β constituents been observed; it was thought, however, that the analogous aspects should only bring about an improvement in the dissolving of the β when the temperature was high.

Point three arose because of a typographical

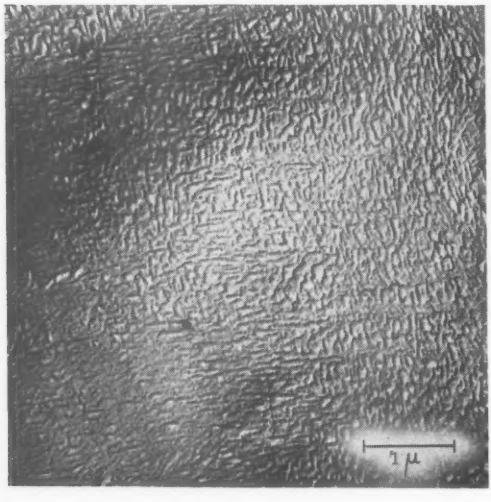


FIG. D.—*Copper/beryllium, 2 per cent., Alloy under the Electron Microscope, showing the appearance of the Modified γ^1 Phase.*

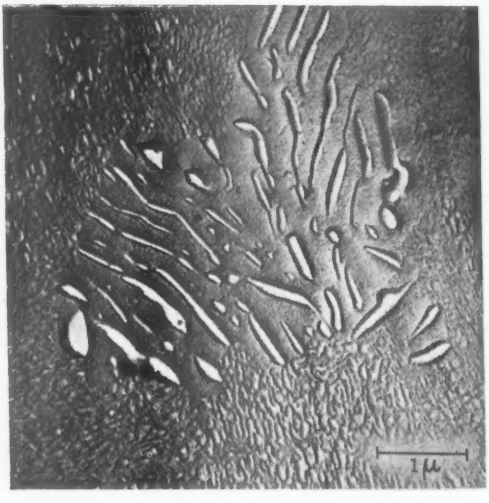


FIG. E.—*Sub-granular precipitate in γ Phase in the Middle of the Matrix of a Copper/beryllium, 2 per cent., Alloy, showing precipitation of γ^1 Phase.*

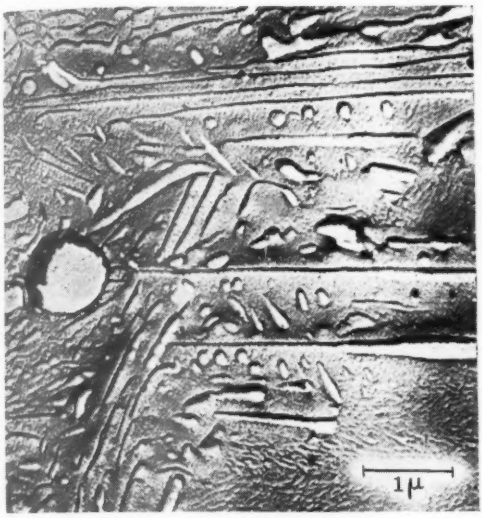


FIG. F.—*Disappearance of γ^1 Phase and Effective Precipitation of γ Phase in a Copper/beryllium, 2 per cent., Alloy produced by prolonging the Tempering Time or Raising the Temperature.*

error in the English translation—there had been some confusion between the phases γ and γ^1. The text to which Mr. Richards and Mr. Smith referred should have read as follows:—"A recent investigation by the research department of the Pechiney Company . . . has shown the precipitation within the α solid solution of a γ^1 phase, causing hardening. If tempering is continued between the optimum period, γ^1 is absorbed in favour of the γ phase . . ." It had been shown, in researches by X-ray, dilatometry, micrography, and electronic micrography (not yet published) that the tempered hardness of copper-beryllium alloys was not due to the precipitation of the γ phase of the equilibrium, but to the precipitation of an intermediary stage, γ^1. Through the medium of X-rays, γ^1 was revealed by the appearance of a diffuse ray between 1.95 and 2.0 Å. The precipitate was submicroscopic, and could be seen in an electronic microscope as now shown in Fig. D. By its appearance, size, and position, accentuated in relation to the matrix, it was very like the X-phase, which, in the Author's opinion, was reponsible for the maximum hardness in 4 per cent. aluminium-copper alloys.* The nearest ray to the γ phase was situated at 1.90 Å and the continual movement of the characteristic γ^1 ray towards the γ ray was not observed. However, what was observed under an electronic microscope was altogether different. Fig. E, for example, showed a sub-granular precipitate with γ in the middle of the matrix where the precipitation of γ^1 was very clear. The γ folia, moreover, were more dispersed around the matrix.

* A. Saulnier and R. Syre, *Revue de Metallurgie*, XLIX, January, 1952.

When, by prolonging tempering or raising the temperature, the effective precipitation of γ took place (accompanied by the disappearance of γ^1) (Fig. F.), the alloy softened in the same way as aluminium/copper alloys did when the X phase was replaced by D^1; γ was then easily visible through an optic microscope.

To sum up, for the scheme: solid solution $\rightarrow$ precipitation of γ accompanied by hardening, then softening when the grains crossed, the Author would like to substitute the following scheme: solid solution $\rightarrow$ precipitation of γ^1 accompanied by hardening $\rightarrow$ precipitation of γ accompanied by softening, accentuated in proportion to the growth of the precipitated folia. It was obviously not a question of returning into solution or bringing γ to normal tempering temperatures.

The development of the β constituents besides its solution had also been studied. The results which were obtained—which were too lengthy to be outlined here—were given in October, 1951, to the *Centre Technique d'Aluminium*, and would no doubt be published soon.

With regard to the fourth point, referred to in the Paper, a general case had been taken, which took note of impurities, in particular of magnesium (see below), which can be present in beryllium-bronze. For this reason, the limits of quenching (in water) had been set between 720 and 800 deg. C., the former having been advised for impure bronze, and the latter for bronze practically free from magnesium. With regard to the tempering, it had been established that the temperature should be cooled from about 300 deg. C. It was advisable to treat the metal at 280-300 deg. C., when it was not too fragile. If maximum hardness were desired to the detriment of elongation, tempering at 320-340 deg. C. was recommended.

The Author would be most interested to know the mechanical characteristics (R, LE, A and H) obtained by Mr. Richards and Mr. Smith by treating sand-cast beryllium-bronze as they indicated: 3 hrs. at 800 to 815 deg. C—water-quenched—tempered 3 to 4 hrs. at 645 deg. C.).

The fifth point concerned an error in the preprint, which was suitably corrected when the Paper was printed in the FOUNDRY TRADE JOURNAL. Owing to the absence of definite indication in the French text, Table IX was entitled "The Influence of Aluminium." This should have been the Influence of 4 per cent. Magnesium. As was shown in the French text, and in the last sentence of the paragraph entitled "Influence of Impurities," the unfavourable influence of aluminium was only perceptible for a content of over about 1.0 per cent.

On the final item, the Author agreed with Mr. Richards and Mr. Smith in admitting (see Table X) that for a bronze tempered above 300 deg. C. one obtained: R = 67 to 83 tons per sq. in.; and H = 350 to 393 Brinell. (The weaker values shown in Table VII referred to an alloy tempered at 280-300 deg. C., as discussed in the first paragraph on "Mechanical Properties.")

Imports and Exports of Iron and Steel in September

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in September. Figures for the same month in 1951 are given for the purposes of comparison and totals for the nine months of 1952 and of 1951 are also included. (All figures in tons.)

Total Exports of Iron and Steel by Destination

Destination.	Month ended September 30.		Nine months September 30.	
	1951.	1952.	1951.	1952.
Channel Islands	440	348	6,563	5,061
Gibraltar	95	133	618	1,477
Malta and Gozo	204	98	2,421	1,714
Cyprus	511	606	3,670	4,718
Sierra Leone	476	294	3,974	3,854
Gold Coast	1,764	2,771	13,901	26,336
Nigeria	2,605	4,470	40,251	34,086
Union of South Africa	11,856	7,190	100,903	102,546
Northern Rhodesia	1,898	1,820	11,463	20,954
Southern Rhodesia	3,390	2,247	28,884	40,212
Tanganyika	1,246	1,489	12,949	15,728
Kenya	1,966	4,637	37,201	31,946
Uganda	520	835	4,132	4,877
Mauritius	277	426	4,999	4,362
Bahrein, Qatar, and Trucial Oman	682	2,070 606	5,808	13,134 10,811
Kuwait	4,710	5,273	67,522	55,083
India	4,615	4,046	57,212	54,009
Pakistan	5,570	2,925	56,141	55,445
Malaya	1,493	1,317	20,291	16,967
Ceylon	358	319	3,888	2,758
North Borneo	1,591	1,569	41,488	17,171
Hongkong	19,229	17,518	247,137	225,361
Australia	7,692	11,995	76,564	109,758
New Zealand	25,967	16,854	201,157	140,703
Canada	1,094	1,445	14,254	20,395
Jamaica	2,482	2,478	29,180	33,777
Trinidad	319	413	4,177	4,532
British Guiana	849	1,202	7,058	14,237
Anglo-Egyptian Sudan	2,354	2,785	18,098	24,406
Other Commonwealth	3,210	4,950	65,092	47,039
Irish Republic	22	—	2,258	1,037
Soviet Union	3,383	2,988	27,962	39,805
Finland	10,643	8,822	83,174	85,930
Sweden	2,971	5,078	45,869	47,015
Norway	139	127	2,110	2,265
Iceland	3,920	5,053	58,935	58,272
Denmark	29	—	659	81
Poland	127	87	877	1,091
Germany	5,087	8,512	65,525	76,521
Netherlands	690	490	8,882	6,096
Belgium	193	335	4,371	2,010
France	826	575	8,662	6,800
Switzerland	1,192	1,176	10,682	7,292
Portugal	298	740	3,220	6,893
Spain	2,487	1,031	27,088	8,671
Italy	32	13	367	396
Austria	217	147	7,157	3,620
Yugoslavia	93	548	2,129	2,638
Greece	593	1,080	4,493	6,468
Turkey	1,313	881	6,534	12,289
Netherlands Antilles	173	289	1,758	2,280
Belgian Congo	101	214	1,704	2,540
Angola	499	191	3,052	3,360
Portuguese E. Africa	75	32	1,505	562
Canary Islands	44	63	4,440	1,776
Syria	711	454	9,884	8,432
Lebanon	2,683	888	24,143	11,424
Israel	2,826	3,792	33,450	26,396
Egypt	7	17	1,340	200
Morocco	359	872	924	5,510
Saudi Arabia	2,738	2,429	20,105	36,784
Iraq	1,869	767	58,074	7,532
Iran	747	1,319	10,090	9,354
Burma	1,026	816	12,480	7,612
Thailand	287	1,159	6,324	11,520
Indonesia	14	82	4,656	273
China	24	403	2,619	4,042
Philippine Republic	3,071	1,657	123,440	36,212
U.S.A.	60	303	2,933	1,718
Cuba	690	300	6,575	3,203
Colombia	1,151	2,399	32,823	30,139
Venezuela	638	434	1,585	3,306
Ecuador	574	381	9,368	6,269
Peru	336	85	6,273	2,485
Chile	1,598	1,766	17,202	19,048
Brazil	645	131	9,140	3,569
Uruguay	2,218	1,003	33,332	27,824
Argentina	1,259	3,178	14,068	18,253
Other foreign	170,141	168,236	2,011,737	1,810,270
TOTAL				

Total Imports of Iron and Steel and Origin

From	Month ended September 30.		Nine months ended September 30.	
	1951.	1952.	1951.	1952.
India	5	—	12	229
Canada	4,327	19,187	36,208	116,442
Other Commonwealth countries and the Irish Republic	212	682	1,271	4,408
Sweden	1,394	3,001	15,905	22,001
Norway	4,645	6,028	38,681	49,545
Germany	2,050	13,858	16,554	85,715
Netherlands	7,789	24,124	56,389	127,104
Belgium	15,009	23,462	128,487	231,494
Luxembourg	9,767	20,599	64,352	132,915
France	23,325	32,765	187,565	233,486
Austria	232	26,530	19,013	145,126
U.S.A.	7,784	40,545	31,500	467,181
Other foreign countries	791	16,774	3,942	183,459
TOTAL	77,330	227,555	599,879	1,799,105
Iron and steel scrap and waste, fit only for the recovery of metal	45,641	82,919	469,780	530,835

Total Exports of Iron and Steel by Group

Product.	Month ended September 30.		Nine months ended September 30.	
	1951.	1952.	1951.	1952.
Pig-iron	494	408	14,691	2,989
Ferro-tungsten	76	11	372	82
Other ferro-alloys	91	187	1,619	2,554
Ingots, blooms, billets, and slabs	130	15	5,160	141
Iron bars and rods	509	255	7,117	2,574
Steel and tinplate bars and wire rods	1,083	20	10,851	907
Bright steel bars	1,080	1,237	24,597	10,368
Alloy steel bars and rods	1,192	1,394	12,025	11,978
Other steel bars and rods	8,204	10,239	136,432	83,951
Angles, shapes, and sections	8,861	7,435	121,994	96,210
Castings and forgings	1,143	1,056	8,869	9,098
Girders, beams, joists, and pillars (rolled)	2,078	1,063	30,643	25,984
Hoop and strip	8,699	3,926	56,967	35,553
Iron plates and sheets	16	15	1,630	364
Tinplate	13,568	21,425	180,006	216,238
Tinned sheets	65	206	1,906	1,422
Terneplates and decorated tinplates	43	67	1,310	693
Other steel plate (⅛ in. thick and over)	16,533	17,391	202,196	174,296
Galvanized sheets	5,169	3,552	41,718	43,661
Black sheets	11,470	10,127	114,801	98,703
Other coated plates and sheets	359	1,263	6,775	8,474
Cast-iron pipes up to 6 in. dia.	7,806	5,687	61,296	65,648
Do., over 6 in. dia.	3,924	4,491	52,364	49,913
Wrought-iron tubes	20,734	27,479	295,116	308,871
Railway material	9,915	12,082	168,114	152,320
Wire	3,528	3,846	44,622	38,178
Cable and rope	1,814	2,232	21,949	22,526
Wire nails, etc.	1,168	1,195	20,471	8,521
Other nails, tacks, etc.	262	202	3,066	3,483
Rivets and washers	734	667	5,551	4,833
Wood screws	373	143	2,967	2,961
Bolts, nuts, and metal screws	2,476	1,424	21,088	17,285
Baths	1,208	359	10,664	10,102
Anchors, etc.	1,072	774	7,076	7,404
Chains, etc.	856	658	7,629	8,393
Springs	461	232	4,702	4,277
Holloware	2,389	2,476	26,119	26,207
Doors and windows	1,957	1,378	15,811	15,951
TOTAL, including other manufactures not listed above	170,141	168,236	2,011,737	1,810,270

Co-operation between Purchaser and Supplier

Special Session at the Annual Convention of the Joint Iron Council

During the afternoon of October 9 a public session was introduced into the Annual Convention of the Joint Iron Council for a general discussion on co-operation between purchaser and supplier of iron castings and what follows is an abridged account of the proceedings:—

THE CHAIRMAN, Mr. N. P. Newman, vice-president of the Council, in welcoming the guests, who were consumers of ironfoundry products, expressed the hope that many would join in the discussion and be outspoken. The subject was to be introduced by Sir Ewart Smith, technical director of Imperial Chemical Industries, who during the war years had been Chief Engineer of Armaments Supply in the Ministry of Supply and had spent a good deal of time in cutting out much of the "red tape" which existed in regard to the design and supply of the products for which he was responsible. He would be followed by Dr. J. G. Pearce, director of the British Cast Iron Research Association, and then later by Dr. Angus, development manager of the Association.

Objective Approach

SIR EWART SMITH said he had been much impressed by reading the reports of the various productivity teams, and not the least by the report on the grey-iron foundry industry. He considered it to be first class. It really put its finger on many aspects where the industry could learn from America, and if what was learned was applied there was no reason why British founders could not beat American or any others. There was no limit to what could be done if the proper mental approach, attitude and drive, were adopted, and founders were clear about their purpose and the means to be employed to achieve it.

The first main tool was a critical analysis of everything that they did—the objective approach. Analysing the inter-relation of the producer, the user, the designer and the research man, there were the following angles: first of all the research angle; the production angle, *i.e.*, the actual production in the shop; the user angle or the sales angle, because in research, production and use the salesman was very often the connecting link; finally, in the middle of the postulated triangle there was a big "D," which could represent design, using it in its widest sense, or it could represent development and design.

The designer integrated the known facts about a job and in his drawings and specifications put out to the production side what in fact was to be made. In the speaker's view, however, it should not stop there, because if the production side were alive they would say "Why is it to be made this way? How can it be done better?" They would be able to suggest to the designer how much better or how much more cheaply or effectively they could make something if only the design were altered in a certain way, or took account of some new technique. It was well known that good development and design was a process of continuing integration and re-integration.

Requirements from Staff

The need for the fullest collaboration between all parties was exceedingly important, and speaking as a user of castings and engineering plant and equipment, if he put out an order for something to a firm and they thought he was being foolish, if they believed that they had knowledge which he did not possess, if they thought they could offer him something which would be better, or if only he would alter some detail of his requirements they could provide something which was better or more quickly or more cheaply made, then that firm should say so. He was always willing to be instructed, but how often did a salesman go out and get an order for anything within a firm's capacity, and because he had that order the design and production department just made it, even if it was a casting which really had not enough machining allowance on it. How often was it appreciated that the overall interests of all parties were one? They all had the same fundamental requirements and the same real interest.

There was clearly a need for a sufficient number of people trained to think, and if they were to increase productivity and efficiency they had to pay attention to a phrase upon which he had recently noted that someone was lecturing—"the high cost of low overheads." That was terribly true, although it should be borne in mind that the converse was not true: one could have very high overheads and they could be very costly if they were not good overheads, but it was quite certain that under present conditions what was wanted was brains and not brawn; thought and scientific knowledge and not just the brute force of the human machine working harder. It was essential that the brain should work harder and more efficiently.

Next, there was the need for the proper application of research knowledge. It was often said of this country that we produced a lot of fresh knowledge by research but that we did not use it very quickly or effectively, and many people would have to admit that there was much truth in that. All the knowledge in the world was useless to an

individual or an organization unless he or it was in a position to apply it promptly and effectively.

Ferment of Development

DR. J. G. PEARCE said that during the period in which he had been associated with the ironfounding industry he had never known it in such a ferment of development as it was at the present time. Many of those possibilities related exclusively to the process or to the mode of production and they did not concern the user directly at all; for example, in cupola-melting practice there were water-cooled linings, basic as distinct from acid linings, the use of heated blast, and the cupola patching gun; in moulding and core sands the use, in place of linseed oil, of synthetic-resin bonds; in malleable the use of gas annealing, or in moulding practice the use of snap and pop-off moulding flasks; or improvements in foundry hygiene and productivity.

Other improvements, however, were of such a character that they called for the active co-operation of the user of castings, which could be illustrated by two developments where the user could assist both the founder and himself by a co-operative approach to a problem which concerned both parties. These two developments related to nodular-graphite iron, and to the moulding process, which had become known as shell-moulding.

Referring first of all to nodular-graphite iron, members would be aware that in making an iron casting of varying sections in one piece it was necessary to have carbon in the raw material, which in the casting existed in the free state as graphite. In 1948 it was shown in the laboratories of the British Cast Iron Research Association that graphite could be produced in the as-cast state in the form of nodules or spheroids; the process involved essentially the addition of cerium metal to a suitable base iron. That process was quickly followed and independently developed in the United States by the International Nickel Company, their process involving the use of magnesium. In either of those ways the whole of the graphite in a machinable cast iron existed in the form of spheroids instead of plates, and thus at a stroke produced a bigger improvement than the whole of the previous twenty-five years of research designed to improve cast iron. Not only were the ordinary tensile and transverse properties about doubled, and shock resistance increased several times, but there was a considerable measure of ductility and strengths of the order of 35 to 45 tons per sq. in. could be met, with something like 5 to 7 per cent. elongation in the as-cast condition. After a simple anneal, strengths of the order of 25 to 35 tons per sq. in. with up to 20 per cent. elongation with a marked reduction of area were possible. It was clear from those startling figures that a virtually new material had been placed at the disposal of the engineer, and commercial production had begun.

Shell Moulding

The second point concerned what was now familiar to many as shell-moulding. During the last few years, encouraged particularly by the wartime shortage and the high price of linseed oil, synthetic resins had been used very successfully for bonding cores, and shell moulding represented a development of that principle. Where castings were required in sufficient quantity to justify a metal pattern the conventional mould could be replaced by a comparatively thin shell, which was hard and strong and permeable enough to resist the pressure of the molten metal. The technique adopted was to take a sand and incorporate with it a suitable synthetic resin in proper proportion. One then took a metal pattern—and it was essential that the job should be big enough to justify a metal pattern—and heated it to a prescribed temperature and then allowed the sand/resin mixture to fall on to it from a height of 15 to 18 in., and in a few seconds the layer of sand adjacent to the pattern had hardened sufficiently to permit the rest of the sand to be taken away for re-use later on. The depth of sand which had hardened was possibly one-eighth to three-sixteenths of an inch, and the shell was finished by curing it in an oven for a further few seconds. Then the shell could be stripped off, assembled with its mirror image and poured forthwith. In one recorded case a half-shell was ready for use in 120 secs., and it might be possible, in a number of cases, to produce one in 90 secs.

Advantages

The process was, of course, a good deal more expensive than conventional moulding because both the pattern and the resin were expensive, but it had several undoubted advantages, some of which redounded to the benefit of the user. Shell-moulded castings had much smoother surfaces than the ordinary iron castings and were dimensionally much more accurate. They reproduced design details better than ordinary sand and they could, in fact, be arranged to dispense with, or almost eliminate, certain machining and grinding operations and thereby cut down the overall cost of production. To the founder, also, there were some advantages, particularly in the extent to which it could be adapted to mechanical production, and in addition they could be stored indefinitely without loss, could be made by unskilled labour, and certain cleaning operations in the foundry were simplified or completely cut out which, from the point of view of foundry hygiene, was a very great asset. The ability of the founder to realise those advantages depended very largely on close co-operation with the user and his designer. The dimension across the joint of a shell-moulded casting was, of course, the most difficult to maintain, but in the dimensions taken wholly within the shell a casting a foot long had been made in quantity with a maximum variation of ± 0.01 in. In addition, joint trouble could now often be taken care of in the pattern. Shell cores could also be produced, although with more difficulty.

One large American automobile producer was known to be producing shell-moulded castings to a very large extent. With an investment of some

$8,000,000 in equipment, the firm was making 40,000 off one component per eight-hour shift, and that in steel; they were making 4,000 to 5,000 of another in grey iron, and that casting (weighing 85 lb. when finished) was poured two to a shell from only 200 lb. of molten metal. It had been estimated that machining and grinding costs had been cut roughly by one-half, and molten metal was also saved. He strongly urged the various departments concerned with design and manufacture of castings, whether they were within one organization or at one geographical location or not, to explore together the possibilities of the production of engineering castings suited to those methods on a basis of overall cost, rather than merely foundry cost.

Present Position

Many patents for refinement and improvement of the shell-moulding process had been taken out —hundreds in the United States alone—but basically there did not appear to be any obstacle to experiment and development on the part of anybody who cared to do so. The large American corporation which was producing nodular iron in shell moulds was said to be pouring 150 tons of metal a day in that way. Fifteen per cent. of the weight of cast iron in the one engine was now said to be shell-moulded, and that if all engine castings, except the block and head, made in cast iron, were shell moulded, there would be 40 per cent. of the weight of the engine and 150 parts altogether, doubtless in a range of engines. To indicate its impact in other fields, it was reported that shell-moulding was now absorbing between 2,000,000 and 3,000,000 lb. of resin per annum in the United States, and the suppliers of synthetic resin said that if 5 per cent. of all castings were shell-moulded by 1957, which seemed to be a very conservative assumption, some 80,000,000 lb. of resin would be required annually, which was two-thirds of the total current demand for all moulded plastic material. It had been stated in the United States that shell-moulded iron castings up to 250 lb. and steel castings up to 50 or 60 lb. had been successfully produced.

SIR PERCY MILLS said he had been very interested in Sir Ewart Smith's talk, but held that there should be a very much closer relationship between research and production, which would help to overcome the delay in applying research which had been mentioned. He agreed that the draughtsman, or designer, should have a certain amount of foundry experience and should know the technique of founding and the difficulties and hazards involved. If founders received a drawing or an inquiry, they should not hesitate to approach the user with suggestions for simplifying that design. It was up to the user to consider the matter and to state whether it would affect the ultimate result. He had experienced many cases where, by doing that, the cost had been reduced by at least half.

[Extracts from the Discussion, which disclosed several examples of dissatisfaction with the products of ironfoundries, will be printed next week.—EDITOR.]

Parliamentary

The White Paper

Extract from the speech of MR. D. SANDYS (Minister of Supply) last Thursday, when moving approval of the Government's policy on the iron and steel industry:—

"One of the main problems in the years ahead is going to be the buying from abroad of sufficient quantities of raw materials. Since the war, the industry has been buying its foreign ore through its central buying organization, and this system has worked smoothly and efficiently. Nothing in the White Paper will prevent the continuance of those arrangements should they continue to be desirable. The board would have the continuing duty of keeping under review the whole question of the supply of raw materials for the industry. Should the industry at any time fail to ensure adequate supplies of raw materials, the board will be given power to make other arrangements."

Referring to the boundaries of the sphere of the responsibilities of the board, he said: "Our aim is to provide a system of public supervision which, by and large, will embrace the whole of the iron and steel industry and, at the same time, not extend beyond it." The White Paper included a list which, in the main, embraced the processes of iron and steel production. "Others have been included for two reasons—to ensure their supply of materials, and to make the board's supervision over the basic processes fully effective. Almost without exception, those that have been included have expressed their approval. I am aware there is a certain amount of uneasiness among certain sections of the founders, particularly steel founders and what are called the tied foundries linked with engineering works. They are afraid the board will use its powers to interfere with the day-to-day running of their business. Their fears and anxieties are not justified." The board would only have power to control major schemes which were of such magnitude as to affect the balance of the industry. "Few, if any, foundry development schemes will come into that category. If they should, it is only reasonable that they should be subject to scrutiny in the same way."

Most castings were not easily susceptible to detailed price control, and no doubt the board would recognize that. The issue of price control was largely academic so far as the tied foundry was concerned. The iron and steel founders together consumed no less than 5,500,000 tons of pig-iron and scrap a year. If left outside the scope of the board, the board would have no direct responsibility for looking after their supply of raw materials. "There is no scheme which will give complete satisfaction to everyone. I believe that the proposals in the White Paper offer a fair basis for a workable solution."

Census of Production

When WING COMMANDER HULBERT (Con., Stockport, North) asked the President of the Board of Trade the policy of his department in regard to the continuance of the census of production, MR. H. G. STRAUSS, Parliamentary Secretary, who replied, said that in order to reduce statistical work to the minimum required to meet the essential needs of Government and industry, the censuses for the years 1952 and 1953 would be based on sampling methods, as a result of which a large proportion of the smaller and medium-size establishments would not have to make returns. This was in accordance with the advice of the Advisory Committee, he said.

Brassfoundry Methods

The article on "Brassfoundry Methods" printed in last week's issue was abstracted from a Paper given by Mr. L. W. Gummer to the Brassfoundry Productivity Conference, and made reference to a number of illustrations in the original Brassfoundry Productivity Report. The illustrations referred to were omitted last week but are reproduced on this page.

Figs. 1 and 2 show the layout and mode of operation of a device for forcibly removing a workman's hand from the danger point on a machine. Figs. 3 and 4 illustrate simple and effective methods, respectively, of placing small components close to hand and a platform hoist serving a stores.

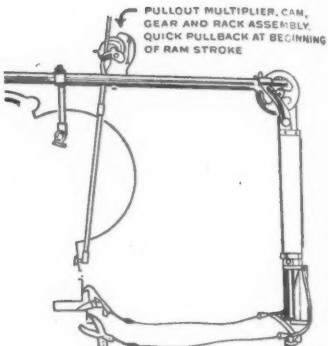
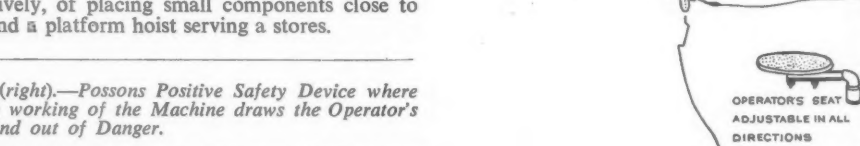

PULLOUT MULTIPLIER, CAM, GEAR AND RACK ASSEMBLY. QUICK PULLBACK AT BEGINNING OF RAM STROKE
OPERATOR'S SEAT ADJUSTABLE IN ALL DIRECTIONS

FIG. 1 (*right*).—*Possons Positive Safety Device where the working of the Machine draws the Operator's Hand out of Danger.*

FIG. 2 (*below*).—*Sequence of Operation of the Possons Safety Device attached to a Press.*



(1) Placing the item, stroke up.

(2) Stroke half-down, fingertips practically free.

(3) Dies at the closed point, operator's hands in a safe position.

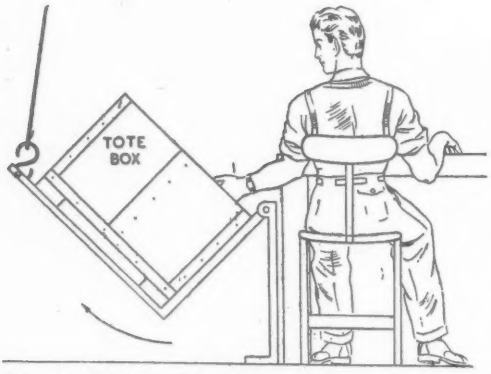


FIG. 3.—*Tilting and Raising Device for Placing Castings in a "Tote" Box Conveniently at Hand. The "Tote" Box is usually delivered by Fork-lift Truck.*

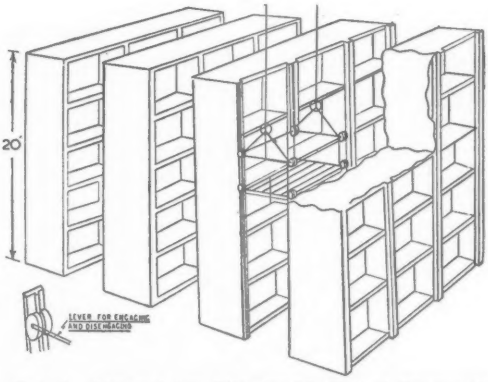


FIG. 4.—*Unusual but Effective Method of Storage for Fairly Heavy Dies or Pattern Plates using a Cradle suspended from Electric Hoists.*

Personal

MR. HUGH M. SANDS, M.I.B.F., managing director of Arthur Green, Limited, machine-tool makers, Old Whittington, near Chesterfield, has returned after a visit to Canada.

BRIG. W. H. CROSLAND, representing the iron and steel industries, will lead the mission sponsored by the Board of Trade to the dollar countries of Latin America which leaves early in November.

MR. S. A. CLARKE, progress manager for a number of years of Gent & Company, Limited, manufacturing electrical engineers, of Leicester, has been appointed a director of the company, which he joined in 1910.

AMONG the appointments announced at the recent meeting of the Council of the University of Leeds was that of Mr. F. R. Mobbs, M.Sc., as lecturer in mechanical engineering, from January 1, 1953.

MR. HORACE A. PRESTON, recently retired from his post as works manager of Ruston & Hornsby, Limited, engineers, etc., of Grantham. He had been associated with the firm for 49 years, and for over 20 years had been works manager.

SIR HAROLD WEST, managing director of Newton Chambers & Company, Limited, ironfounders, structural engineers, etc., of Thorncliffe, near Sheffield, is to be chairman of the new governing board of the Loughborough College Institute of Technology.

MR. J. F. WILLSHER, formerly production controller of George Kent, Limited, Luton, Bedfordshire, has been appointed production manager, responsible for both material control and production control, following the recent death of Mr. H. W. Cain, material controller.

MR. ERIC WEISS, managing director of Foundry Services, Limited, Nechells, Birmingham, 7, is at present visiting the company's agents in Europe and Asia. His tour will take him to Italy, Turkey, Greece, Israel, and South Africa. The visit to South Africa is in connection with the formation of an associate company there.

MR. H. HUBBARD has been appointed a director of Oakley Brothers Limited. This Company, which is a subsidiary of W. T. Henley's Telegraph Works Company, Limited, has a modern foundry at Cradley, Cradley Heath, Staffs., for the production of grey iron castings. Mr. Hubbard is manager of the Engineering Sales department of the holding company.

MR. NORMAN PERCIVAL WOODWARD, a demonstrator employed by John Lund, Limited, machine-tool makers, of Eastburn Foundry, near Keighley, was attacked in Liége, Belgium, on October 24, by four men who kicked him on the head and took £30 in travellers' cheques and £4 in notes. After receiving first-aid treatment at a hospital, Mr. Woodward was able to return to the Liége plant, where he was doing work for his firm.

MR. JOHN BRUCE, who has been in the foundry profession for the past 30 years, has arrived in Karachi. He will advise foundrymen on all the aspects of iron and steel castings with a view to improving the quality, quantity and size of the products. When his mission in Karachi is completed he will undertake similar work in the other regions of Pakistan. His work is under the auspices of the U.N. Technical Co-operation scheme.

TWO DIRECTORS of Vickers-Armstrongs, Limited, who have recently joined the board of the parent company, Vickers, Limited, are MAJOR-GENERAL C. A. L. DUNPHIE and MR. P. H. MUIRHEAD. Major-General Dunphie has been associated with the Vickers group since 1948, and was appointed a director of Vickers-Armstrongs in 1951. On the death of Commander Sir Robert Micklem, in May of this year, he was appointed managing director, engineering works and shipyards, of Vickers-Armstrongs, Limited. Mr. Muirhead was appointed director in charge of the naval yard of Vickers-Armstrongs, Limited, in 1950, in addition to his position as general manager.

NEWLY APPOINTED manager of the Birmingham district office of Metropolitan-Vickers Electrical Company, Limited, is MR. R. ALLEN, who succeeds MR. A. F. BOCK. Mr. Allen joined the then British Westinghouse Company as a trade apprentice in 1916 and won a company's scholarship to the Manchester College of Technology. In 1921 he joined the motor engineering department, and in 1926 transferred to the general engineering department, where he dealt with industrial electrification schemes. He transferred to the Birmingham office as senior plant sales engineer, handling switchgear transformers, rolling mill and colliery equipment, etc., in 1947, and was appointed assistant manager in May of this year.

Obituary

MR. WALTER RATLEY has died, aged 79. Until recently he was a representative for W. A. Hudson, Limited, brass founders, of London.

MR. THOMAS P. CAMERON, foundry director, who has died at Lenzie, was associated with Southbank Ironworks, Kirkintilloch, from 1890 until his retirement in 1946.

THE DEATH occurred on October 24, in London, where he was attending the Motor Show, of MR. JOHN WILLIAM OGLE, managing director of W. Ogle & Son, Limited, agricultural engineers, of Bradford.

MR. DENIS MACHELL HOLLINS, the pioneer in this country of the automatic loom, died on October 23, aged 72. Mr. Hollins was chairman and managing director of the British Northrop Loom Company, Limited, of Blackburn.

COLONEL JAMES S. A. WALKER, vice-chairman of Walker Bros. (Wigan), Limited, manufacturers of mining machinery, etc., died recently at the age of 65. He joined Walker Bros. in 1906 as an apprentice and subsequently became chairman of the company in 1933 on the death of his father. On the amalgation of the firm with Walmsleys, of Bury, in 1946, he was made deputy chairman.

MR. ROBERTSON BELL, of Bonnybridge, who has died in a Glasgow hospital, was a director of Smith & Wellstood, Limited, for 22 years and, although he retired from active day-to-day affairs of the company just over a year ago, he retained his seat on the board. He started his service with the firm in the Glasgow offices and later was transferred to London area. He went to the head office at Bonnybridge in 1919 and soon afterwards was appointed office manager.

MR. G. N. GUEST, who has died at the age of 77, was a former president of the Birmingham Chamber of Commerce and honorary secretary of the Chamber for the past four years. Mr. Guest also had a long association with the Engineering and Allied Employers' Association and for nine years was president, while he had been secretary of the local district since 1918. A member of the Institute of Mechanical Engineers, he was for two years chairman of the Birmingham branch. A Burton-on-Trent man by birth, Mr. Guest was chairman and managing director of Hollings & Guest, Limited, from 1899 to 1932, and from 1919 to 1932 held a similar office with the associated firm of John Hands, Limited. Later he became an executive of Tangyes, Limited. Mr. Guest was a past chairman of the British Industries Fair, becoming honorary treasurer in 1945.

News in Brief

THE SECOND ANNUAL OUTING of the foundry employees of the Grantham Works of Ruston & Hornsby, Limited, took the form of a visit to London.

THE BIGGEST STEEL CASTING ever made in the Parkhead Forge of Wm. Beardmore & Company, Limited, was run out last week. Weighing over 190 tons, it is one of six sole plates on order from America.

THE ALUMINIUM DEVELOPMENT ASSOCIATION are holding a symposium and exhibition of aluminium-alloy castings in Birmingham on November 6 and 7 and in London on November 11 and 12. Participation is by invitation only.

AN APPEAL for more courses in industrial safety to be given in colleges of technology was made by Mr. J. F. Kenny, of Accles & Pollock, Limited, at a meeting of the Birmingham and District Industrial Safety Group on October 21.

A GENERAL MEETING of members of the Victorian division of the Institute of Australian Foundrymen was held at the Metallurgy School, Melbourne Technical College, on Wednesday, September 17. A lecture on "The Shell-moulding Process" was given by Prof. H. K. Worner, of the University of Melbourne.

HOPE that Midland manufacturers will secure some substantial engineering contracts in Canada over the next two years when various industrial expansion schemes in the Dominion begin to operate, was expressed by Mr. Barry Kay, Regional Controller of the Board of Trade, at a conference in Birmingham on October 21.

A GROUP OF METALLURGISTS representing various European countries is now in the United States to study productivity in the American magnesium industry under the auspices of the Organization for European Economic Co-operation. The secretary of the group is Dr. John L. Haughton, consultant to Essex Aero Limited.

AT THE PUBLIC WORKS AND MUNICIPAL SERVICES exhibition at Olympia, November 3 to 8, Broom & Wade, Limited, High Wycombe, Bucks, will be showing portable air compressors and pneumatic tools, including a new type S.V.78 portable compressor delivering 60 cub. ft. of free air per min. at 100 lb. per sq. in. when running at 1,500 r.p.m.

THAT MANY factories in the Black Country, including several foundries, were "living on the camel's hump" was the fear expressed by Mr. A. G. B. Owen, president of the Wednesbury and Darlaston Manufacturers' Association last week. There was such backlog of uncompleted orders that most firms had adequate work for the time being; but, unless new orders came in, a serious position would develop in six months' time.

CONSIDERATION will be given to the making of a Beilby memorial award or awards early in 1953. Outstanding work of the usual nature may be brought to the notice of the Administrators, either by persons who desire to recommend the candidate or by the candidate himself, not later than December 31, 1952, by letter addressed to the Convenor of the Administrators, Sir George Beilby Memorial Fund, Royal Institute of Chemistry, 30, Russell Square, London, W.C.1.

FOUNDRY WORKERS should avail themselves of the X-ray facilities offered by the Home Office, it was emphasized by the jury at an inquest in West Bromwich on October 24 on an employee of a local foundry who collapsed and died at work. A post-mortem showed that death was due to pneumoconiosis and Dr. J. C. Ford, who made the examination, said that the man's lungs were typical of the disease which was caused by the inhalation of dust, the major part of which was silica.

A CENTENARY of interest to foundrymen occurred on October 26, which marked the 100th anniversary of the death of Henry Elkington, co-founder of the Birmingham firm, Elkington & Company, Limited, and the pioneer of electro-plate. Henry Elkington began business in Camden Street, Birmingham, as a caster of bronze figures, in which trade he soon achieved renown, so that several of his products are still to be found in various places in Great Britain, an outstanding example being the statue of the Knights of Malta in the House of Lords.

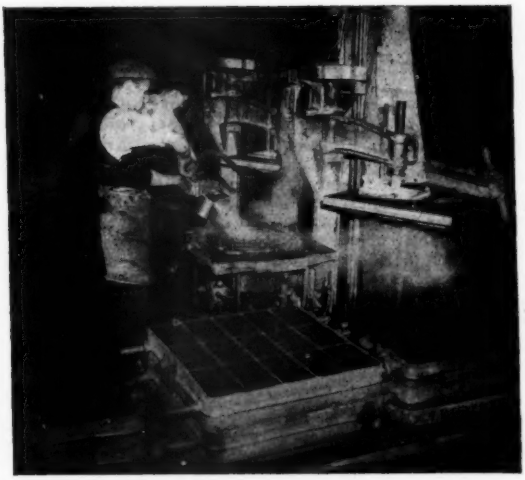
E. P. GIBBS, LIMITED, 17, Charlotte Street, Port of Spain, British West Indies, wishes to secure agencies for U.K. manufacturers of builders', plumbers' and general ironmongers' castings, builders' ironmongery, galvanized hollow-ware, tinned hollow-ware, agricultural implements and tools, etc. Interested makers should communicate with Mr. E. P. Gibbs, at the above address, at the same time notifying the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1 (reference CRE/33620/52), of any action taken.

THE DUKE OF EDINBURGH will, on Monday, November 3, inspect an exhibition at Goldsmiths' Hall showing the work of the City and Guilds of London Institute, of which he is president. The exhibition, entitled "Training for Industry," has been arranged in connection with the Institute's yearly meeting, over which the Duke will preside. It will be open to the public from November 4 to 14, by permission of the Wardens of the Goldsmiths' Company. Features of the exhibition will include a pictorial presentation of the work of the Institute's Department of Technology, which covers nearly 200 subjects.

TWENTY-FOUR FOREMEN from works in the Midlands are attending a course at Moreton Morrell, Warwickshire, this week for a five-day conference on their rôle in industry, organized by the Midland-area training committee of the British Iron and Steel Federation. Mr. J. V. Oates, area training officer of the British Iron and Steel Federation, is among the speakers, who include executives from well-known Midland firms as well as educationists. Discussion groups based on problems raised during lectures are planned to give members of the course opportunity to express views and exchange ideas.

AN IMPORTANT bridge replacement on the Glasgow-Stranraer line was carried out last Sunday by railway engineers on the moorland borders of Ayrshire and Wigtonshire between Glenwhilly and Barrhill. Opened in 1877, the old bridge had three spans of approximately 30 ft., supported by cast-iron intermediate piers. The new bridge has a single span of 65 ft. After the last train passed over the bridge on Saturday night, engineers took possession, removed the old structure, and placed the new girder bridge on new concrete abutments. The track was ready for use for the Irish boat-train passing over the bridge on Sunday evening.

THE POSSIBILITY of Distington Engineering Company, Limited, Workington (Cumberland), having to place some of its work outside the area owing to manpower shortage was referred to by Mr. A. H. H. Douglas, director and general manager, when the company entertained to lunch members of Workington Corporation. He said that if it could get the men needed, the firm's exports in 1953 should be the better part of £1,000,000, most of it for the dollar markets. The company's 1,500 employees were insufficient to occupy the space available, and the directors were considering placing a large amount of work outside.



Illustrations of "PLP" in use by courtesy of Messrs. Henry Wallwork & Co. Ltd., Red Bank, Manchester.

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Raw Material Markets

Iron and Steel

Most foundries continue to find business much scarcer than it has been for some time. Many of the engineering and speciality foundries, for example, which up to a month or two ago were heavily engaged, are not now receiving sufficient business to keep their plants fully operative. The same is true of some of the light and jobbing foundries, while scarcity of business is causing unemployment at some of the textile foundries.

Available supplies of pig-iron are, in the main, sufficient for the current needs of the foundries; even with the present reduced demands, however, there is little to spare. High-phosphorus pig-iron has suffered a decline in production due to the re-lining and repair of two furnaces in the Derbyshire area, while outputs of the low- and medium-phosphorus irons are just about sufficient for present needs. Increased quantities of hematite pig-iron have relieved the supply position for many foundries, but most of the additional tonnages are going to the steelworks.

Supplies of scrap for the foundries are scarce in the heavier and better grades, but light scrap is more plentiful. Foundry coke is coming forward regularly, most foundries appearing to have sufficient for current consumption and also to augment stocks to some extent. Ganister, limestone, and firebricks are received to requirements.

The re-rollers are fairly well occupied, and it is fortunate that business for their products from home sources is maintained, as export orders for merchant bars have almost ceased. Our present prices for small steel bars nullify any prospect of obtaining orders from oversea buyers against the lower rates quoted by Japanese and Continental makers. Deliveries of steel semis, mostly from abroad, have helped considerably in maintaining production, although at present the flow of this material to many of the re-rollers is not so regular, with the result that some are running short of supplies. Sheet re-rollers are very busy. They are in need of larger quantities of sheet bars and slabs to fulfil their home and export commitments. The re-rollers continue to press for defective material and crops, as well as any other materials suitable for conversion, but arisings are small.

Non-ferrous Metals

Although there have been unmistakable signs of late that the European demand for copper has declined, even to the point when tonnage normally consumed on this side is likely to be shipped to the United States, the same cannot be said of conditions across the Atlantic. Indeed, it would seem that great activity still prevails in the United States for, according to details issued by the Copper Institute in New York, deliveries of domestic consumers in September reached the near record-breaking figure of 134,690 short tons, an increase of some 7,500 tons over August. One effect of this was to bring down the total of stocks of refined copper in producers' hands from 83,770 tons to 71,455 tons at September 30. The U.S. output of blister copper was 81,870 tons, about 2,500 tons up on August, while production of refined copper rose from 95,365 tons in August to 98,930 tons in September.

Recently some details were published of copper production in Chile, where a two-day strike was recently settled. In metric tons the September output was about 29,500 tons, of which about half was in the form of fire-refined. Unfortunately, the strike in Northern Rhodesia, where work on the copper belt is entirely suspended, was not resolved in two days, and, at the time of writing, there is no indication of any change for the better. Suspension of production means a loss of approximately 1,000 tons a day, and there is no knowing how long the trouble may drag on, for there has been unrest in this area for some long time past. So far, the Ministry of Materials has not announced any reduction in its allocation to consumers.

To most people's surprise, there was a rise of £9 in the price of aluminium at the beginning of last week, the quotation now being £166. Lead again showed weakness, the market dropping back to £80, but later recovering from that level. Zinc fell away in the United States, with a Custom smelter offering at 12½ cents, equivalent to £100, and yesterday (Wednesday) the Ministry of Materials cut the price of good ordinary brand zinc by £8 to £110 per ton.

The most important item of news last week was Lord Swinton's announcement that the Government had decided to free zinc, the market opening, it was hoped, on January 1 next. Obviously the authorities have been well satisfied with the behaviour of the lead market and are now anxious to return zinc to free enterprise. Stocks are ample—in fact, very large in the U.K.—and consumers are pursuing a hand-to-mouth policy.

Official tin quotations were as follow:—

Cash—Thursday, £951 10s. to £952 10s.; Friday, £952 to £954; Monday, £951 to £952; Tuesday, £951 to £952; Wednesday, £952 to £954.

Three Months—Thursday, £941 10s. to £942 10s.; Friday, £940 to £940 10s.; Monday, £939 to £940; Tuesday, £938 to £940; Wednesday, £937 to £939.

Official prices for refined pig-lead were:—

October—Thursday, £82 15s. to £83; Friday, £85 to £85 10s.; Monday, £88 10s. to £88 15s.; Tuesday, £85 15s. to £86; Wednesday, £83 10s. to £84.

January—Thursday, £82 10s. to £82 15s.; Friday, £84 10s. to £84 15s.; Monday, £88 to £88 10s.; Tuesday, £85 10s. to £85 15s.; Wednesday, £83 10s. to £83 15s.

National Works Visits Day

For the third year in succession, the Institute of British Foundrymen have held a highly successful national works visits day, on which members from all over the country assembled at a selected centre for visits to various establishments, mainly foundries, in the neighbourhood. Last Friday, the Wales and Monmouth branch acted as hosts and nine works in the South Wales area received parties of founders, from 24 to 70 in number, in five main groups. Members, who mainly journeyed to South Wales on Thursday evening, travelled by coach on Friday to and from the various works. Luncheon at midday was usually arranged by the firms visited.*

* Details of the programme were printed in the JOURNAL July 24, and works visited were briefly described in the JOURNALS of October 2 and October 9.

Last Thursday, at the Royal Victoria Hotel, Sheffield, the directors of Gummers, Limited, gave a dinner, presided over by Mr. L. W. Gummer, to celebrate the completion of 50 years' service with the firm by Mr. George Gummer and Mr. W. H. Gummer. Amongst other guests were Mr. N. P. Newman, Mr. S. E. Baker, Mr. F. Leonard Davis, Mr. V. C. Faulkner, Dr. E. Gregory, Mr. P. B. Henshaw, Mr. E. N. Hiley, and Mr. Claude Spofford, most of whom were accompanied by their wives. The two principal guests were the recipients of souvenir presents, Mr. George Gummer receiving a gold cigarette case and Mr. W. H. Gummer a silver tea-service.

ALUMINIUM SOLDERING PROBLEMS SOLVED BY ULTRASONICS

THE PROBLEM of soldering aluminium and other metals that form refractory oxides has at last been overcome by the use of ultrasonics in a practical, commercial form.

The new soldering equipment, developed in the Mullard Laboratories, removes oxide film by ultrasonic cavitation and provides a "clean" metallic surface.

Ultrasonic soldering has special applications in light metal foundries. Here are some of the ways in which it can help you:

- *Blow holes and cavities in aluminium castings quickly and efficiently filled.*
- *Porosity effectively sealed in low-stress aluminium castings.*
- *Alterations to existing aluminium patterns easily and economically made.*

The Mullard Soldering Iron and Amplifier. The unit operates from a.c. mains and is robustly made to suit foundry conditions.

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NON-FERROUS **INGOTS**

Only a balanced combination of skill and science can produce Ingots which are consistent with the specification

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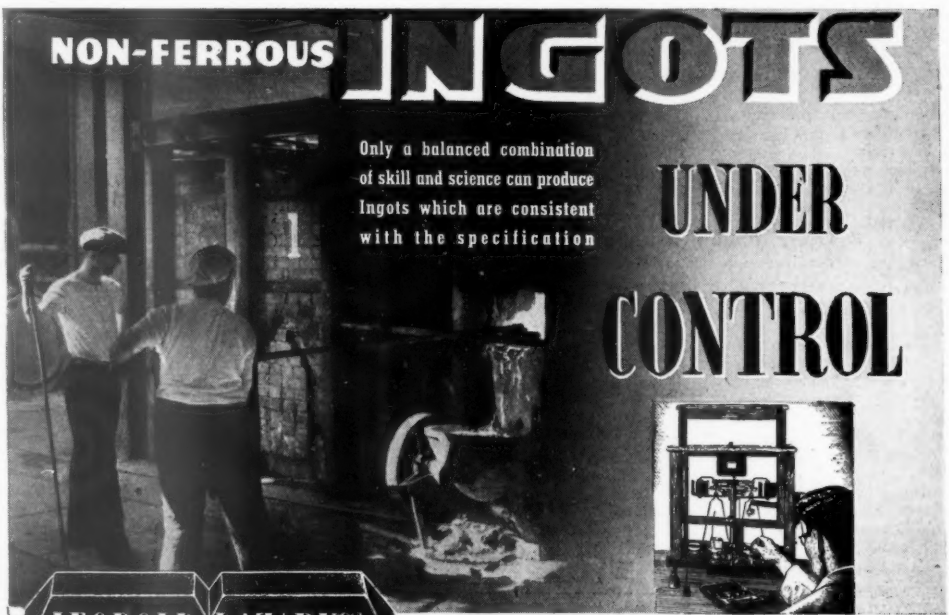

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

October 29, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £16 8s., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £15 19s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 14s. 6d.; South Zone, £17 17s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £18 14s. 6d.; South Zone, £18 17s.

Cold Blast.—South Staffs, £18 2s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £16 2s.; Scotland (Scotch iron), £16 8s. 6d.; Sheffield, £17 3s.; Birmingham, £17 9s. 6d.; Wales (Welsh iron), £16 8s. 6d.

Basic Pig-iron.—£13 19s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 28s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 31s. 7d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr; max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £49 0s. 8d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £41 12s. 6d.; galvanized corrugated sheets, 24 g., £53 3s.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 7s. 9d.; nickel-chrome-molybdenum, £79 2s. 6d.

Tinplates.—57s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £952 to £954; three months, £937 to £939; settlement, £953.

Zinc.—G.O.B. (foreign) (duty paid), £110; ditto (domestic), £110; "Prime Western," £110; electrolytic, £114; not less than 99.99 per cent., £116.

Lead.—Refined pig-lead: October, £83 10s. to £84; January, £83 10s. to £83 15s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, —; rolled zinc (boiler plates), all English destinations, —; zinc oxide (Red Seal), d/d buyers' premises, —.

Other Metals.—Aluminium, ingots, £166; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £64 10s. to £64 15s.; nickel, £454.

Brass.—Solid-drawn tubes, 27d. per lb.; rods, drawn, 37d.; sheets to 10 w.g., 31⅝d.; wire, 32⅞d.; rolled metal, 29⅞d.

Copper Tubes, etc.—Solid-drawn tubes, 32⅜d. per lb.; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £200 to £218; BS. 1400—LG3—1 (86/7/5/2), £215 to £238; BS. 1400—G1—1 (88/10/2), £345 to £375; Admiralty GM (88/10/2), virgin quality, £352 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £355 to £385; L.P.Bl, £250 to £275 per ton.

Phosphor Bronze.—Strip, 44d. per lb.; sheets to 10 w.g., 46½d.; wire, 49½d.; rods, 44½d.; tubes, 42⅜d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9½d. per lb.(7%) to 3s. 10½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3½d. (7%) to 4s. 4½d. (30%); to 12 in. wide × .056, 3s. 3½d. to 4s. 4½d.; to 25 in. wide × .056, 3s. 5½d. to 4s. 6½d. Spoon and fork metal, unsheared, 3s. 0½d. to 4s. 1½d. Wire, 10g., in coils, 3s. 9⅜d. (10%) to 4s. 10½d. (30%). Special quality turning rod, 10%, 3s. 8½d.; 15%, 4s. 1½d.; 18%, 4s. 6½d. All prices are net.